BEAR RIVER BASELINE

2015

Human and Biophysical Attributes of the Bear River Corridor in Cache and Box Elder Counties

Section 1: Introduction

The Utah Division of Forestry, Fire and State Lands (FFSL) is responsible for managing sovereign lands within the State of Utah. These lands consist of the underlying bed of any body of water determined to have been navigable at the time of statehood. In Utah, these bodies of water include, but are not necessarily limited to, Utah Lake, Great Salt Lake, Bear Lake (Utah's half), the Bear River, the Jordan River and portions of the Green and Colorado Rivers (Utah Administrative Code R652-70-100).

In accordance with state law and the Public Trust Doctrine, FFSL is required to manage sovereign lands under comprehensive land management programs to ensure that the protection of navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality is given due consideration and balanced against any benefit to be derived from proposed uses of these resources. To fulfill these obligations, FFSL is required to develop comprehensive management plans for each sovereign land resources in Utah. Currently, there are comprehensive management plans in place for Utah Lake (2009), Great Salt Lake (2014) and Bear Lake (2009), but no plan has yet been developed for the Bear River.

FFSL is sponsoring this research project, the Bear River Baseline, to provide background information and preliminary data to be used in the development of the Bear River Comprehensive Management Plan (CMP). The Bear River CMP will be a coordinated resource management plan employed to guide the implementation of management objectives and provide direction for land use decisions on Utah's sovereign lands along the Bear River (Utah Administrative Code, R652-90-200). As determined in cooperation with FFSL, the primary objectives of this baseline study are to:

- Characterize the Bear River Corridor and its surrounding landscape.
- Identify partners and stakeholders, including agencies with management responsibilities.
- Summarize and integrate existing research and information relevant to the Bear River CMP.
- Identify and map the occurrence of important biophysical and socio-cultural attributes of the Bear River and its surrounding landscape.

The study area for this project is identified in Map 1. While state sovereign lands are limited to those lands directly underlying navigable bodies of water, the study area has been extended to the boundaries of the 8 digit hydrologic units surrounding the Bear River in Cache and Box Elder Counties. The intention behind this expanded study area is to better represent the larger context of the river and its relationship to the surrounding landscape.

Section 2: Background

2.1 State Ownership and Public Trust Responsibilities

State sovereign lands, commonly referred to as submerged lands or public trust lands, are generally defined as lands underlying the ordinary high water mark of navigable bodies of water. Title to these lands is rooted in the longstanding principles of the Public Trust Doctrine and, in the United States, was passed from the federal government to the state upon its entry into the union by virtue of the Equal Footing Doctrine. Utah's state sovereign lands include Utah Lake, Great Salt Lake, Bear Lake (Utah's half), the Bear River, and portions of the Green and Colorado Rivers. These lands are held in trust and managed by the Division of Forestry, Fire and State Lands (FFSL) for the benefit of the general public.

Public Trust Doctrine

Public Trust Doctrine provides that tidal and navigable freshwaters, the lands beneath them, and the living resources that inhabit them are subject to a special title (Slade, 1990). This title is held in trust by the state for the benefit of the general public and establishes the public's right to use and enjoy trust waters, lands, and resources for a wide variety of recognized public uses (Slade, 1990).

The roots of Public Trust Doctrine date back at least as far as the sixth century Institutes and Digest of Justinian, which collectively formed Roman Civil Law (Slade, 1997). Under Roman law, the air, sea and all running waters were held in common by all citizens. All rivers and ports were public and the right of fishing and navigation was common to all. Any person was at liberty to use the seashore to the highest tide, as long as they did not interfere with the use of the resource by others (FFSL, 2013).

The influence of Roman civil law was carried forward into English common law, under which the crown held title to all lands underlying tidewaters. In contrast to Roman Law, English common law only recognized the public's rights to waters and lands subject to the ebb and flow of the tide. It is important to note, however, that England has very few navigable waterways that are influenced by the ebb and flow of the tide. Consequently, the terms "tidewaters" and "navigable waters" were essentially synonymous (Slade, 1990).

English common law became the law of the thirteen colonies and, subsequently, of the thirteen original states. Each of the thirteen original states, therefore, holds (and continues to hold) a public trust interest in all waterways and underlying lands subject to the ebb and flow of the tide. Furthermore, each was given the authority to define the boundary limits of the lands and waters held in the public trust (Slade, 1997).

Equal Footing Doctrine

The Equal Footing Doctrine is a principle of Constitutional law that requires that states admitted into the Union after 1789 be admitted as equals to the original thirteen colonies in terms of power, rights, and sovereignty.

In 1787, just before the ratification of the U.S. Constitution, the Northwest Ordinance established guidelines for the Northwest Territory as well as for the admission of new states into the union. Specifically, it provided that any state joining the Union shall be admitted "on an equal footing with the original states" in terms of power, rights, and sovereignty. As each of the 37 "new" states were created, this provision was included as a part of their enabling legislation and created a transfer of the title to public trust lands and waters from the federal government to the respective state at the time of statehood.

For some time, the United States continued to adhere to the English common law definition of navigable waters, which only defined tidal waters (subject to the ebb and flow) as part of the Public Trust. However, the geography of the United States is very different from that of England. The United States contains a multitude of large, non-tidal rivers and lakes that have long been used for commercial navigation, fishing, and other uses that would have been protected as public trust resources under Roman Law.

In 1845, the United States Supreme court extended the jurisdiction of federal district courts to include navigable, non-tidal waterways in response to several conflicts between commercial vessels operating on inland waterways. In the 1876 case, *Barney vs. Keokuk*, the Supreme Court held that "all waters are deemed navigable which are really so" and that "there seems to be no sound reason for adhering to the old rule as to the proprietorship of the beds and shores of such waters." Further, the court held that "[such lands and waters] properly belong to the States by their inherent sovereignty" (Barney vs Keokuk,

1876). In the United States, therefore, public trust waters and underlying lands include both tidal waters as well as non-tidal, navigable waters.

Utah's Sovereign Lands

As with all states admitted to the union since Tennessee's admission in 1796 (Justia, 2012), the Utah Enabling Act, enacted on July 16, 1894, officially declared Utah "to be admitted to the Union on an equal footing with the original States" (Utah Enabling Act, 1894). Title to public trust waters and lands in the state of Utah were, therefore, transferred from the federal government to the state at the time of statehood on January 4th, 1896.

Utah's public trust lands are referred to as "sovereign lands" and are defined as "those lands lying below the ordinary high water mark of navigable bodies of water at the date of statehood and owned by the state by virtue of its sovereignty" (Utah Code §65a-1-1(4), 2015). These lands include, but are not necessarily limited to, Utah Lake, Great Salt Lake, Bear Lake (Utah's half), the Bear River, and portions of the Green and Colorado Rivers (Utah Administrative Code R652-70-100).

Utah Code §65A-1-2 and §65A-10-1 establish the Division of Forestry Fire and State Lands as the management authority for Utah's sovereign lands. Utah Code §65-A-2-1 states that the "division [of Forestry, Fire and State Lands] shall administer lands under comprehensive land management programs using multiple-use, sustained yield principles."

> *"The state of Utah recognizes and declares that the beds of navigable waters within the state are owned by the state and are among the basic resources of the state, and that there exists, and has existed since statehood, a public trust over and upon the beds of these waters. It is also recognized that the public health, interest, safety, and welfare require that all uses on, beneath or above the beds of navigable lakes and streams of the state be regulated, so that the protection of navigation, fish and wildlife habitat, aquatic beauty, public recreation, and water quality will be given due consideration and balanced against the navigational or economic necessity or justification for, or benefit to be derived from, any proposed use"* (Utah Administrative Code R652-2-200).

Therefore, the overarching management objectives of FFSL are to provide for the reasonable and beneficial use of sovereign land while ensuring the long-term protection and conservation of sovereign land resources. There is no particular hierarchy of uses, but the implementation of the multiple-use

framework and other legislative policies is subject to consistency with Public Trust obligations and must avoid substantial impairment of Public Trust resources (GSL, 2013). Consequently, FFSL, as trustee of the state's sovereign land resources, strives for an appropriate balance among compatible and competing uses for the lands under it's jurisdiction.

2.2 Stakeholder Roles and Responsibilities

The Division of Forestry Fire and State Lands (FFSL) is "the executive authority for the management of sovereign lands" in Utah, including sovereign lands along the Bear River (Utah Code 65A). However, there are several other agencies, organizations, and stakeholders that play important roles in the management of resources along the Bear River. These include federal, state, and local government agencies, non-profit organizations, private enterprise, and even individual landowners throughout the Bear River Corridor. The Bear River Comprehensive Management Plan and the associated planning process provide an opportunity for increased coordination and collaboration among state and federal agencies, local governments and other stakeholders.

Division of Wildlife Resources (DWR)

The Division of Wildlife Resources is the wildlife authority for Utah and is responsible for protecting, propogating, managing, conserving, and distributing protected wildlife throughout the state (UTAH CODE §23-14-1). DWR manages both protected and non-protected wildlife species, regulates hunting and fishing, and manages a limited number of wildlife management areas and access points along the Bear River.

Division of Water Resources (DWRe)

The Utah Water Quality Board and Division of Water Resources is responsible for directing the orderly and timely planning, conservation, development, protection, and preservation of Utah's water resources to meet the beneficial needs of Utah citizens. It conducts studies, investigations, and planning activities for water use. Currently, the Division of Water Resources is working with consultants to explore options for developing water from the Bear River to support growth and development in Northern Utah.

Division of Water Rights (DWRi)

The Utah Division of Water Rights (DWRi) regulates the appropriation and distribution of water in the State of Utah, pursuant to Title 73 of the Utah Code. The State Engineer, who is the director of DWRi,

gives approval for the diversion and use of any water, regulates the alteration of natural streams, and has the authority to regulate dams and dikes to protect public safety.

Division of Oil, Gas, and Mining (DOGM)

The Division of Oil Gas and Mining (DOGM) is the regulatory agency for mineral exploration, development, and reclamation in the state of Utah pursuant to Title 40 of the Utah Code. While there is currently no significant exploration along the Bear River, DOGM oversees such activities on the Great Salt Lake and would be the regulatory agency for any future activities that could take place along the Bear River.

Utah Geological Survey (UGS)

The Utah Geological Survey (UGS) is a non-regulatory agency responsible for collecting, preserving, publishing, and distributing reliable information on geology, mineral resources, and geologic hazards relevant to the state of Utah. UGS is also responsible for assisting, advising, and cooperating with state and local agencies and state educational institutions on all subjects related to geology.

Utah Division of Water Quality (DWQ)

The Utah Division of Water Quality and the Utah Water Quality Board are responsible to protect public health and beneficial uses of water by maintaining and enhancing the chemical, physical, and biological integrity of Utah's waters – including both surface and groundwater resources. Title 19, Chapter 5 of the Utah Code charges the board and division to develop programs for prevention and abatement of water pollution. Their activities include the establishment of water quality standards, regulation of treatment facilities and wastewater discharge, and carrying out planning processes to control water pollution.

Utah Division of Air Quality (DAQ)

The Division of Air Quality (DAQ) and the Air Quality Board address air pollution issues and work to shape related environmental policies. They are responsible for developing state implementation plans (SIP), issuing permits, conducting compliance activities, and partnering with other government agencies to protect air quality in the State of Utah.

U.S. Army Corps of Engineers (USACE)

The United State Army Corps of Engineers jointly administers Section 404 of the Clean Water Act with the U.S. Environmental Protection Agency and is responsible for regulating the placement of fill material and excavation in the nation's waters. USACE's management responsibilities under the CWA are to protect the nation's aquatic resources from unnecessary adverse impacts. This includes the regulation and permitting of various activities, including the disturbance of wetlands.

U.S. Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) jointly administers Section 404 of the Clean Water Act with the U.S. Army Corps of Engineers. The EPA also has direct regulatory responsibilities for the Superfund Program under the comprehensive Environmental Response, Compensation, and Liability Act. They have partnered with UDEQ to implement both Clean Water Act and Clear Air Act programs in the state of Utah.

U.S. Fish and Wildlife Services (FWS)

The U.S. Fish and Wildlife Service (FWS) manages the Bear River Migratory Bird Refuge at the mouth of the Bear River west of Brigham City. The USFWS is responsible for the protection of migratory birds as well as threatened and endangered species (Gwynn 2002). FWS staff from the Bear River Migratory Bird Refuge have been active participants in several planning studies and projects along the Bear River.

Natural Resource Conservation Service (NRCS)

While the Natural Resource Conservation Service (NRCS) doesn't have direct management responsibilities along the Bear River, they play an important role in providing technical assistance in conservation planning and land management practices. NRCS strives to work in close partnership with farmers and ranchers, local and state governments, and other federal agencies to maintain healthy and productive working landscapes (NRCS, 2013). Their programs include technical and funding assistance to landowners interested in improving conservation practices on agricultural lands along the Bear River.

Cache and Box Elder Counties

The entirety of the study area lies within Box Elder and Cache Counties. While not responsible for directly managing land areas along the Bear River, counties do exercise an influence over many areas through local policy-making and county-level zoning ordinances. These policies affect the distribution of land uses such as agriculture, commercial and residential activities as well as important guidelines for

flood plains and other critical lands in terms of public health, safety and welfare. The counties and municipalities (below) are also important stakeholders in terms of water use. For example, the recently release Cache County Water Master Plan identifies the development of 60,000 acre-feet of water from the Bear River as a top priority for meeting the future water needs in Cache County (Cache County, 2013).

Municipalities

Local municipalities within the study area also affect land uses through municipal zoning and code enforcement. Of the 33 incorporated cities and towns within the identified study area, there are 9 that are located directly adjacent to the Bear River. These include Cornish, Lewiston, Trenton, Amalga, Deweyville, Elwood, Honeyville, Bear River City, and Corinne. Map 13 shows municipal boundaries and generalized zoning classifications.

PacifiCorp/Rocky Mountain Power

PacifiCorp controls four hydro-electric facilities along the Bear River. They also hold the exclusive right to divert water from the Bear River for storage in Bear Lake and operate the Lifton Pumping Station to move water from Bear Lake back into the Bear River to fulfill contracts with downstream water users during the dry season.

In addition to operating the dams and pumping station, PacifiCorp owns approximately 1900 acres of property along the Bear River in Cache County. These lands are collectively known as the "Bear River Bottoms" and were acquired by Utah Power and Light in 1981 as part of a settlement agreement with property owners whose lands were being flooded by high runoff (BRLC, 2012). Many of these lands are managed to protect and enhance wildlife habitat as well as leased for grazing. PacifiCorp also provide recreational facilities that support canoeing, hunting, and bird-watching in areas around the Cutler Reservoir and Marsh.

Conservation Organizations

There are several conservation-oriented organizations that have a growing interest in lands and resources along the Bear River. The Bear River Land Conservancy holds a conservation easement on approximately 500 acres of property (owned by PacifiCorp) in Cache Valley and is working to develop additional easements along the river. The Nature Conservancy (TNC) has identified the Bear River as a

conservation priority and is actively engaged in the Conservation Action Planning Process within the Bear River Watershed. TNC is also working to facilitate conservation easements throughout the area. The Bridgerland Audubon Society has a long history with the Bear River Watershed, owns/manages parcels of land in Cache Valley, and has identified areas around the Great Salt Lake, the Amalga Barrens and Cutler Marsh as "Important Bird Areas" of global significance (National Audubon Society, 2013).

Private Property Owners

The vast majority of land adjacent to sovereign lands along the Bear River is privately owned and used for agricultural activities (refer to map 11). While FFSL has management authority for the bed of the Bear River, these landowners control and manage the adjacent lands that have a significant effect on most aspects of the river, including water quality, vegetation, and wildlife habitat. Private landowners will, therefore be a critical partner and resource for FFSL both during the planning process as well as the implementation of future management activities along the Bear River.

2.3 Previous studies and planning efforts relevant to the Bear River CMP

Although the responsibility for planning and management of state sovereign lands along the Bear River lies with FFSL, other state agencies, public entities, and private stakeholders also have management responsibilities and significant interests in resources along the Bear River Corridor. The Bear River Comprehensive Management Plan and the associated planning process provide an opportunity for increased coordination and collaboration among state and federal agencies, local governments and other stakeholders.

The Bear River has received increased attention over the past several years as a critical resource for wildlife habitat as well as an important water resource to support future development in the State of Utah. Population growth in Cache and Box Elder Counties has spurred a number of projects evaluating the impacts of changing land uses within the region. Consequently, there are a number of studies and reports that provide a significant body of information relevant to state sovereign lands management along the Bear River. Where applicable, this report takes advantage of these previous research projects and planning documents to provide the context and background for this study. Many of the following references are also cited as key sources of more detailed information that has been synthesized to create this baseline report.

Lower Bear River and Tributaries TMDL (2002)

The Lower Bear River TMDL is an Environmental Protection Agency (EPA) mandated report that is required to be developed for any water body that is listed as impaired for meeting its designated beneficial uses. This report was developed utilizing information submitted by Ecosystems Research Institute through a locally administered contract with the Bear River Water Conservancy District. It provides an overview of the study area, identifies designated beneficial uses, pollutants of concern, and both point and non-point sources of pollution for the Bear River from Cutler Dam to the Great Salt Lake. The recommended implementation strategy focused on reducing non-point source pollution to the river because point source pollution was determined to be a very small contributor to the impairment of the stream.

Since this TMDL was completed, there have been several changes in the area, including the expansion of light industry and additional factors affecting non-point source pollution. A new TMDL study is currently under development that will address these issues. The new TMDL for the Lower Bear River is expected to be complete by the end of 2016 (Allred, 2015).

Bear River Basin: Planning for the Future (DWQ, 2004)

This document was prepared by the Utah Division of Water Resources as part the Utah State Water Plan series. It is intended to guide and direct water related planning and management in the Bear River Basin. The document identifies water use trends and, where possible, makes projections of water use. Additionally, it explores various means of meeting future water demands, and identifies important issues for making water-related decisions with in the Bear River Basin.

Box Elder County, Utah Resource Assessment (NRCS, 2005).

The Box Elder County Resource Assessment was completed through the cooperation of the Utah Association of Conservation Districts, the Utah Department of Agriculture and Food, and the Natural Resources Conservation Service to provide an assessment of important natural and social resources in Box Elder County, Utah. The assessment is primarily focused toward agricultural resources and issues. The intention of the report is to aid in resource planning, identify needs for conservation assistance, and outline specific resource concerns for the area.

Alternative Futures for the Bear River (Toth et al, 2005)

The 2004 -2005 Bioregional Planning Studio at Utah State University completed the project entitled "Alternative Futures for the Bear River Watershed." This project was oriented to addressing three central questions for residents in the entire watershed. 1) How can quality of life issues for the local population be represented or defended in the face of development, 2) How can we maintain clean air and water, and 3) Can prime agricultural and a rural lifestyle be maintained, including the preservation of open space and access to public lands as well as the benefits of a small community lifestyle for its residents? There was no single plan proposed in the study but rather a series of alternative future scenarios were identified and allocated across the region based upon expected 20-year growth predictions. To evaluate the alternative scenarios, a series of assessment models were developed to analyze where each scenario may compromise quality of life concerns as well as those related to public health, safety, and welfare.

Planning for the Bear River Corridor through Cache County (Baker, 2006)

Jay Baker did a Plan B Masters Project, Planning for the Bear River Corridor through Cache County in 2006 that sought to identify lands valuable for the preservation and improvement of riparian, wetland, and upland areas that would be the most cost-effective for acquisition. This project provides one example of an approach to identifying and managing lands critical for sustaining ecological systems and habitat values along the Bear River.

Cache Valley 2030 (Toth et al, 2006)

Cache Valley 2030: The Future Explored looked specifically at Cache Valley to identify how projected future growth might affect the regional identity and ecological integrity of that area. This project produced suite of alternative future scenarios based upon an expected 25-year growth prediction. Similar to the other bioregional planning projects employing the development of alternative futures, several assessment models were developed to analyze how and where each futures could compromise quality-of-life and public health, safety, and welfare.

Bear River: A last chance to change course (Denton, 2007)

The book, *Bear River: Last Chance to Change Course,* provides an overview of the Bear River system, its history, and some of the issues that it continues to face. While certainly not a technical document or a planning study, it is included here as reference that synthesizes a lot of useful information regarding the

cultural history and development within the Bear River watershed, ranging from ancient geomorphologic events, human settlement, and the present day context of the river.

Linked Communities in Box Elder County (Profazier, 2010)

This report is the result of a Plan B thesis project completed by Landon Profazier in 2010. The project provided land use assessment models to identify deficiencies in the Box Elder County General Plan. Additionally, Profazier developed some relatively complex models for determining "attractiveness to development" in the area around Brigham City and evaluated the effects of alternative planning scenarios on the increasing sprawl of development in Box Elder County.

Bear River Watershed and its role in maintaining the Bear River Migratory Bird Refuge (Toth et al, 2010)

At the same time Landon Profazier was completing his thesis project, the 2009-2010 Bioregional Planning Studio was working on a watershed-level project exploring growth and development within the Bear River Watershed and, specifically, potential impacts to the Bear River Migratory Bird Refuge. While the focus of this study was directed toward the refuge, it presents a thorough analysis of the Bear River Watershed as a whole including growth and development, agriculture, critical wildlife habitat, and public health, safety and welfare. The report provides an evaluation of alternative future scenarios that were developed and provides corresponding recommendations for implementing policies aimed at preserving critical resources within the region.

Middle Bear River and Cutler Reservoir TMDL (2010)

This TMDL document was developed by the Utah Department of Environmental Quality in consultation with SWCA Environmental Consultants to meet the requirements of the Clean Water Act in addressing water quality impairments for Cutler Reservoir and the Bear River in Cache Valley, UT. Similar to the Lower Bear River TMDL described previously, this document provides an overview of the defined study area, identifies designated beneficial uses, impaired uses, pollutants of concern, and sources of pollution contributing to the impairment of the Bear River and Cutler Reservoir.

Cache County, Utah Resource Assessment (NRCS, 2011)

The Cache County Resource Assessment was developed to provide guidance for resource management plans and identify conservation assistance needs for natural and cultural resources in Cache County, Utah. Similar to the Box Elder County Resource Assessment described above, the report provides an

overview and general observations of resources within the region and identifies resources priorities and concerns related to agricultural preservation, water resources, invasive weed species, and the condition of grazing lands.

Environmental Assessment and Land Protection Plan: Proposed Bear River Watershed Conservation Area (USFWS, 2013).

More recently, the U.S. Fish and Wildlife Service has been working on developing the "Bear River Watershed Conservation Area" and Land Protection Plan. The document highlights resource values including agricultural lands, wildlife habitat, and water resources within the watershed and evaluates the projected environmental and socio-economic impacts that may occur upon implementation of the conservation area and land protection plan.

The implementation of this plan would utilize voluntary conservation easements to protect wetlands, grasslands, and agricultural lands from being converted to other uses in order to preserve wildlife habitat in the watershed. Approval to move forward with the plan has been given by the US Fish and Wildlife Service and project leaders are in the process of identifying priority areas and working with landowners to develop voluntary conservation easements that would be accepted into the program as donations from the respective landowners.

Envision Cache Valley

Envision Cache Valley is the culmination of an extensive public visioning process that began with the Cache Valley Regional Council – a group created by an agreement between Cache Valley jurisdictions and made up of elected officials from Franklin County, Idaho, and Cache County, Utah. A steering committee of local citizens with diverse backgrounds led the Envision Cache Valley effort. The Cache Valley Regional Council asked Envision Utah, a nonprofit organization that pioneered regional visioning, to facilitate Envision Cache Valley.

In a very general way, Envision Cache Valley summarizes how residents think Cache Valley should grow. The objective was to envision a place that preserves and enhances the quality of life that residents currently enjoy and that future generations will appreciate. Public preferences expressed at ten workshops were used to create alternative growth scenarios. Residents weighed on components of the scenarios at 13 town hall meetings and online. Components favored by the public were used to create a

vision statement, vision principles, and vision scenario maps to evaluate projected consequences. Participants explored various issues including location and patterns for future growth, private property rights, transportation, air quality, water quality, economic development, job growth, agriculture, land consumption, housing, environment, critical lands, and recreation.

Conservation Action Plan (TNC, 2009)

Conservation Action Planning is a is a framework developed by the Nature Conservancy to identify and understand key species and ecological systems most in need of conservation, the factors that sustain or degrade them, and the necessary strategies to effectively protect them. The Conservation Action Planning process for the Bear River was initiated in 2009 and is intended to bring partners together to synchronize their individual conservation work and identify opportunities for collaboration in the effort to sustain important ecological systems in the Bear River Basin. The Bear River Conservation Action Plan is an ongoing effort to review the progress made toward achieving conservation objectives and identify future plans and strategies that can be taken by participating individuals and entities.

Final Great Salt Lake Comprehensive Management Plan (FFSL, 2013)

The Utah Department of Natural Resources and the Division of Forestry, Fire and State Lands jointly sponsored the development of the Final Great Salt Lake Comprehensive Management Plan in conjunction with SWCA Environmental Consultants. This management plan is included here for two reasons. First, it provides an example of Utah sovereign lands planning and includes a (legally vetted) summary of the role and authority of FFSL in managing state sovereign lands according to multiple use, sustained yield objectives in accordance with the Public Trust Doctrine. Additionally, the Bear River is the single largest source of water flowing into the Great Salt Lake and the interface between the two water bodies provides an expansive area of wetlands and mud flat habitats that represent one of the most critical areas for wildlife in the region. The importance of this area is well represented by the presence of the Bear River Migratory Bird Refuge.

Section 3: Biophysical Attributes

The study area defined for this project, shown in Map 1, includes portions of three 8-digit hydrologic units that form part of the larger Bear River Basin. The Bear River Basin, in turn, lies in the northeastern portion of the Great Basin. (Utah Board of Water Resources, 1992). From its headwaters in the Uintah Mountains, the Bear River flows more than 500 miles along a circuitous path, making a large u-turn from north to south around the northern end of the Bear River Mountain Range and eventually flows into the Great Salt Lake just 80 miles from its source. It is the longest river in the Western Hemisphere that does not, ultimately, flow into an ocean (Denton, 2007).

3.1 The Bear River Basin

At one time, much of the Bear River Basin was covered by the ancient Lake Bonneville. The Bear River, however, was not always connected to the giant inland lake, but flowed northward through the Portneuf River Canyon into the Snake River Basin. Following this course, the waters of the Bear River would have ultimately flowed into the Pacific Ocean via the Snake and Columbia Rivers (Link et al, 1999).

Approximately 50,000 years ago, however, volcanic eruptions associated with the wake of the Yellowstone Hot Spot produced natural dams that diverted many stream drainages (Bouchard et al, 1998). It is thought that the northward flow of the Bear River was blocked by a Quaternary basalt flow that now forms the northwestern rim of the Thatcher basin, located in the southern end of the Gem Valley. This blockage redirected the Bear River southward into Lake Thatcher (Bouchard, et al., 1998) and established the Bear River's connection with the Bonneville Basin. As the levels of both Lake Bonneville and Lake Thatcher rose, erosional processes began incising the divide between the two and eventually cut through the Oneida Narrows near Thatcher, Idaho (northwest of Preston).

The connection between the Bear River and Lake Bonneville increased is estimated to have increased water flow into the Bonneville Basin by as much as 33% (Link, et al, 1999). This addition of water, coupled with a period of cool and moist conditions, is generally thought to have been responsible for Lake Bonneville reaching its all-time high elevation of approximately 5,090 feet (Bouchard et al., 1998). This lake level was likely controlled for a period of time, probably less than 500 years (Oviatt and Miller, 1997), by small overflows across the Zenda Threshold (5,090 feet in elevation) and subsurface leakage through Red Rock Pass (Link and Phoenix, 1996). Eventually, however, the natural dam at Red Rock Pass

(Zenda Threshold) suffered a cataclysmic failure (Malde, 1968; Scott et al., 1983; Jarrett and Malde, 1987; O'Connor, 1993). Slopes crumbled and Lake Bonneville spilled northward into Marsh Valley through the Portneuf Gap and out onto the Snake River Plain. Evidence of the massive flood that ensued, considered to be the second largest that is known to have occurred in the world (Jarret and Malde, 1987), extends as far northward along the Snake River as Lewiston, Idaho (O'Connor, 1993).

Following the flood, Lake Bonneville remained at the Provo shoreline (the same elevation as the bedrock lip at Red Rock Pass) for about a thousand years until it began to rapidly recede approximately 13,000 years ago (Link et al., 1999). As the lake receded, the Bear River followed it southward through the Cache and Bear River Valleys to where it now flows into the Great Salt Lake near the Bear River Migratory Bird Refuge. Because of its complex geomorphologic history, the Northward flowing section of the Bear River from the Uintah Mountains to Soda Springs is very old, while the southward flowing sections from Soda to the Great Salt Lake are really quite new in terms of geologic history (Link et al, 1999).

3.2 Geology

The study area contains portions of two distinct physiographic provinces, defined by rock types, deformation, and erosional characteristics (Fenneman, 1931). The Mountains to the East are part of the Middle Rocky Mountain Physiographic Province. The Basin and Range Physiographic Province, which contains the flat bottom valleys and Bear River Corridor, begins at the base of the Bear River Mountain Range and extends westward. The Wellsville and Clarkston Mountain Ranges break up the Basin and Range Province, dividing Cache Valley from the Bear River Valley. Landforms and terrain features within the watershed consist of a series of gently sloping terraces, alluvial fans, and rolling uplands that step up into the steep slopes of more mountainous terrain. For the purposes of this project, the area has been divided into three basic types of areas based primarily on elevation and topography: mountains, foothills, and valley bottoms.

Mountains

The Bear River Mountain Range that runs north-south in the central part of the Bear River Basin is characterized by Precambrian and Permian sedimentary and metamorphic geological formations. The Wellsville and Clarkston Mountains that divide Cache and Box Elder Counties have a similar geologic

makeup. Dominant rock types include dolomite, limestone and quartzite. Most valleys within these mountain ranges have been incised by streams flowing downward from higher elevations through V-shaped fluvial canyons. These streams typically have steep stream grades and surrounding slopes with bottoms consisting primarily of boulders and cobble (UDWQ, 2010).

Foothills

Foothills and benches provide a transition between the steeper, mountainous areas and the flat valley bottoms. They are generally made up of sedimentary deposits left over from the days of Lake Bonneville. These deposits provide fertile agricultural soils, but also leave many of these areas susceptible to erosion. There are a number of alluvial deltas that were formed by the interaction of rivers and streams with the former Lake Bonneville. Many of these alluvial deltas were subsequently carved by streams to form alluvial canyons with moderate stream grades and gravel bottoms that extend through the foothills and out onto the valley floors.

Valley Bottoms

The Cache and Bear River Valley bottoms are relatively flat, with more undulating terrain at the edges, an occasional bluff, and the meandering ravines carved by rivers such as the Bear and the Malad. The deposition of sediments carried downstream by the Bear River as it flowed into Lake Bonneville created much of the rich farmland that exists in the lower lying portions of the Cache and Bear River Valleys. The bedrock and soils of these

http://utahdar.org/chapters/bearriver/valley.jpg

valley bottoms are composed of alluvial and lake deposits of varying thicknesses.

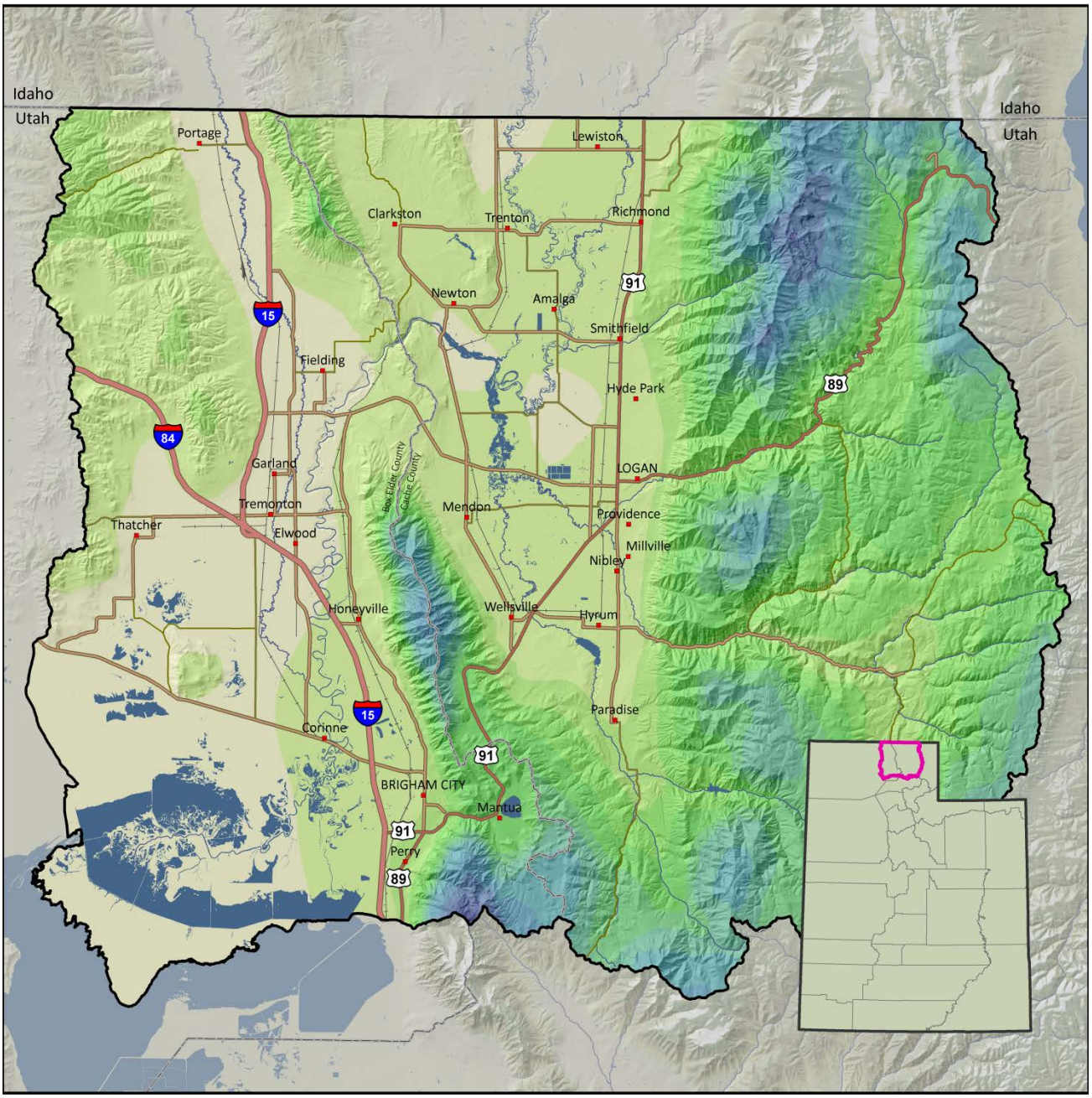
3.3 Climate

The diverse topology of the Bear River Basin creates a widely varying climate. Mountains and high elevation valleys experience long, cold winters and relatively cool summers. Lower elevation foothills tend to be relatively temperate, and southeasterly aspects, in particular, often provide microclimates that have historically allowed for fruit production in the region. Valley bottoms experience warm temperatures in the summer, but generally have a more extreme variance between high and low temperatures due to cold air from higher elevations being pushed downward into lower lying areas.

Mountainous terrain has a tremendous impact on the distribution of precipitation. As a general rule, average precipitation has a direct relationship with elevation. As air masses are propelled upwards towards the atmosphere, they carry water vapor from evaporation and evapotranspiration of surface water and vegetation (Brutsaert, 2005). At higher elevations, water vapor condenses and begins to cool. Once the air reaches a certain temperature, water particles become too large and fall from the atmosphere in the form of rain, snow, or hail through the process of precipitation. Simply put, precipitation generally increases at higher elevations. Some areas in the lower valleys receive as little as 10 inches of average annual precipitation while higher elevation areas of the surrounding mountains may receive well over 50 inches (see Map 2).

Major storm systems impacting the region include frontal systems coming from the Pacific Northwest during the winter and spring as well as thunderstorms that approach from the south and southwest in late summer and early fall (Utah Division of Water Resources, 2004). With the majority of storm systems that carry significant amounts of water approaching from the west, mountain ranges cause significant rain shadow effects in some areas of the valleys. East facing slopes and significant portions of the valley bottoms are left relatively dry, while the west-facing slopes and adjacent areas of the valleys (such as those near Brigham City and Logan) receive significantly higher amounts of precipitation.

Map 2: Average Annual Precipitation



3.4 Water

A watershed (also referred to as a basin, or drainage) is a basic hydrologic unit representing the area of land where all water running underneath or over the surface drains to a common water body such as a river, stream, wetland, lake, or ocean (USEPA, 2014).

As discussed previously, the physical and climatic characteristics of the Bear River Basin (a large watershed) have a significant impact on the distribution of precipitation throughout the region. High elevation areas and west facing slopes receive relatively more precipitation than lower elevations and east-facing slopes. As precipitation falls to the ground, it either infiltrates or runs across the surface of the earth. Water running across the surface of the earth (i.e. surface water) can form as runoff, become flow in rivers and streams, or be deposited into water bodies such as lakes, ponds, wetlands, or oceans (Gutting, Houghten, & Snyder, 1979). The Bear River Basin, therefore, is a complex system within which hydrologic processes, soil composition, land cover, and land uses ultimately determine the quality and quantity of water delivered into the Bear River from the surrounding landscape.

The Bear River is the largest river in the Bear River Basin and the largest source of water flowing into the Great Salt Lake (FFSL, 2013). Its major tributaries include the Smith's Fork, Cub, Logan, Blacksmith Fork, and the Little Bear River. Of these, all but the Smith's fork flow into the Bear River within the identified study area. The hydrology of the Bear River Watershed has been significantly altered by human settlement and activities over the past century. Within the larger Bear River Basin, there are six hydroelectric plants on the main stem of the Bear River and over 450 irrigation companies that own and operate water delivery systems (DWQ, 2010).

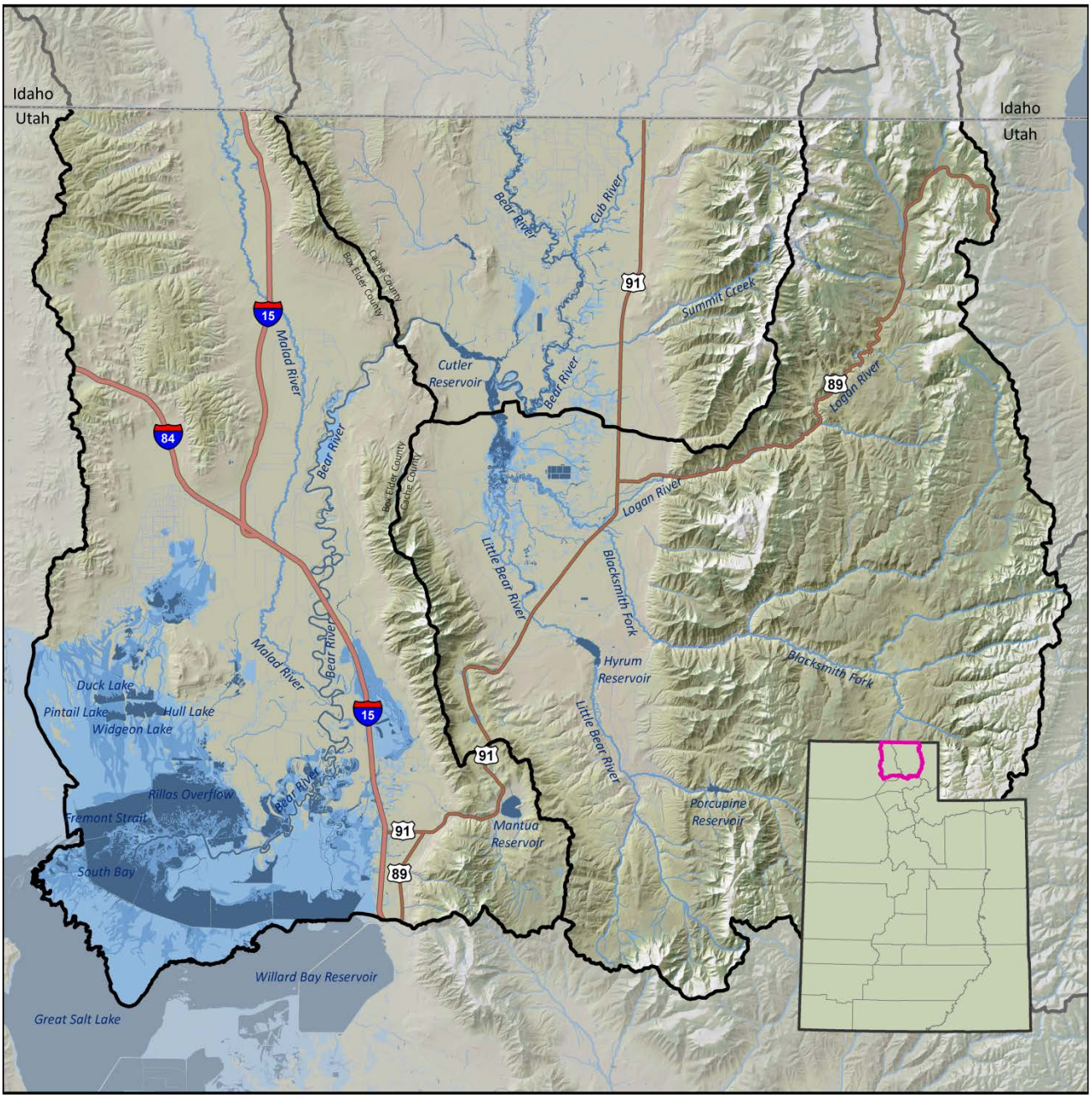
In 1911, a canal was constructed to connect the Bear River to Bear Lake, which had been hydrologically disconnected for approximately 11,000 years (Link et al, 1999). During periods of higher flow and lower water demands (generally from late October through early June), water is diverted from the Bear River at Stewart Dam, flows through Mud Lake, and is ultimately stored in Bear Lake. During the drier summer months, water is pumped from the north end of Bear Lake at the Lifton Pumping Station, runs north through the dingle marsh and Bear Lake Outlet Canal, and is released back into the main channel of the Bear River to supplement low flows and provide water to downstream users (DWQ, 2010).

Between Bear Lake and Cache County, the Bear River makes its wide u-turn around the northern end of the Bear River Mountain Range and transitions from north-flowing to south-flowing near Soda Springs, Idaho, where it is impounded in Alexander Reservoir, and again at Grace. The river then flows southward through the volcanic rock of Black Canyon and past the Grace Power Plant. Continuing southward the Bear River leaves the Gem Valley near Thatcher, Idaho, and is once again impounded at Oneida Reservoir before finally entering Cache Valley through the Oneida Narrows canyon northwest of Preston, Idaho.

The Bear River enters Cache County and the state of Utah at the Utah-Idaho state line. According to a USGS gauge located near the border, the 30 year average annual flow volume from 1986 to 2015 was approximately 773 cubic feet per second (CFS). In Cache Valley, the Bear River is generally characterized by slow water velocities and a shallow stream gradient. Meandering its way back and forth across the valley, the Bear River has carved a large, flat-bottomed ravine that contains a complex channel system with many oxbows, backwaters, eddies, and side channels.

Cutler Dam, located in the Bear River Canyon near the Box Elder-Cache County line, impounds water from the main stem of the Bear River as well as the Logan, Blacksmith Fork, and Little Bear Rivers along with several canals and sloughs in Cache Valley. The dam was constructed in 1927 by Utah Power and Light, now PacifiCorp, and is operated both to provide agricultural water as well as power generation. As part of PacifiCorp's Federal Energy Regulatory Commission (FERC) license, an operational elevation range of 4,406 to 4,407.5 feet has been established for Cutler Reservoir in order to support fish and wildlife populations. With an average water level of 4407 feet in elevation, the reservoir volume is approximately 8,181 acre feet and spreads across some 10,000 acres of open water and wetland areas in Cache County (UDWQ, 2010). Cutler Reservoir's outlets include the West Side Canal, the Hammond Main Canal, and the lower Bear River.

Map 3: Surface Water



Below Cutler Dam in Box Elder County, the Bear River continues its meandering path through a complex channel system and flat bottomed ravine similar to that found upriver in Cache Valley. One marked difference, however, is that summer flows in northern Box Elder County are significantly lower due to the impoundment and diversion of water at Cutler Dam.

During the summer irrigation season, the supplemental water previously stored in Bear Lake is entirely diverted at Cutler Dam and only enters the lower Bear River in the form of seepage and agricultural return flows. At times, the water flow measured below cutler dam may be less than 60 cubic feet per second (cfs) in the summer months (PacifiCorp, 2014). The river slowly gathers water from other sources as it moves southward to the Great Salt Lake, but the entire water yield within the confines of the Lower Bear River Valley – including the inflow of the Malad River – adds less than 10 percent of the Bear River's total flow (UDWQ, 2002). According to the USGS gauge near Corinne, the 30 year average annual flow between 1986 and 2015 was approximately 1280 cubic feet per second (cfs).

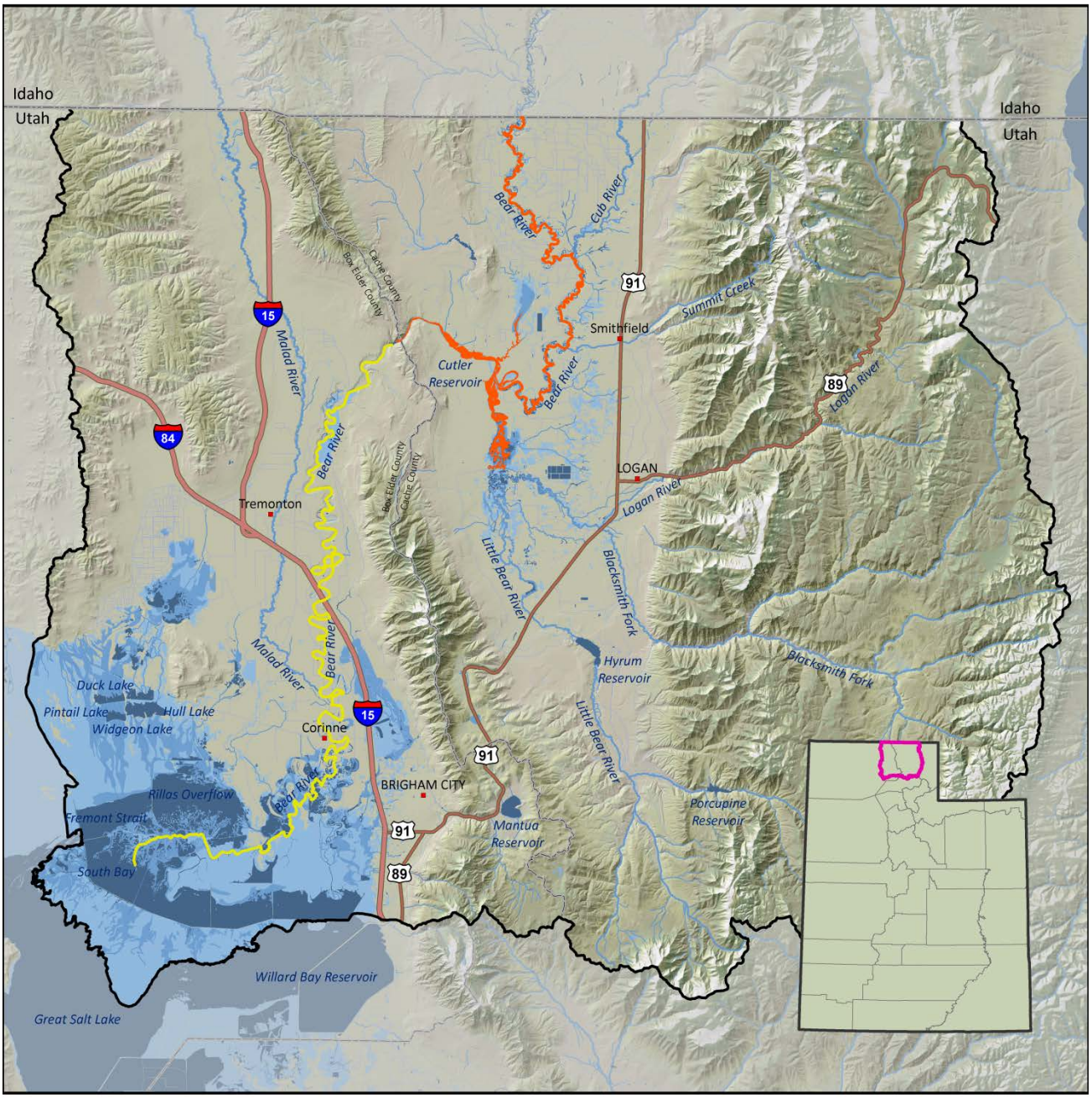
Water Quality

The Federal Water Pollution Control Act (FWPCA) is the primary federal legislation that protects surface waters such as lakes and rivers. This legislation, originally enacted in 1948, was further expanded and enhanced in 1972 when it became known as the Clean Water Act (CWA). The primary purpose of the CWA is "to improve and protect water quality through restoration and maintenance of the physical, chemical, and biological integrity of the nation's waterways" (UDWQ, 2010). The CWA provides a mechanism for evaluating the nation's waters, establishing designated beneficial uses and defining water quality criteria to protect those uses in specific water bodies.

Section 303(d) of the CWA further requires each state to submit a list of impaired water bodies that fail state water quality standards to the U. S. Environmental Protection Agency every two years. For each impaired water body or segment thereof, the CWA requires the completion of a Total Maximum Daily Load (TMDL) study for each pollutant responsible for the impairment of designated beneficial uses. Following the identification of pollutant loads discharged from point and nonpoint sources, controls can be implemented to reduce daily loads until the water body is brought back into compliance with the established water quality standards. As directed by Utah Code 19-5-104, Water Quality Act, the Utah Department of Environmental Quality (UDEQ) is responsible for developing TMDL studies in the State of Utah.

TMDL studies generally include a regional overview of the study area and its hydrology, the designated beneficial uses of the identified water body, the impaired uses, the primary pollutants of concern, and the point and non-point sources of those pollutants. Additionally, the TMDL identifies an appropriate maximum daily load and implements controls to bring the water body back into compliance with established standards. Several TMDL studies have been completed for water bodies within the identified study area, including two that apply directly to the main stem of the Bear River. The Cutler Reservoir and Middle Bear River TMDL study was completed in 2010 and covers the area from the Utah-Idaho border to the Dam at Cutler Reservoir. The Lower Bear River and Tributaries TMDL was completed in 2002 and covers the main stem of the Bear River from Cutler Dam to the Great Salt Lake. An updated TMDL for the lower Bear River is scheduled to be completed by the end of 2016.

Map 4: Water Quality (TMDL) Studies



Both the Middle and Lower Bear River segments as well as Cutler Reservoir have the following four designated beneficial uses:

1. *Secondary contact recreation (2B):* Secondary contact recreation refers to activities such as boating and wading where full immersion does not occur. Waters with this designated beneficial use are required to maintain low bacteria counts to maintain healthy conditions for recreational users.

2. *Warm water game fish (3B):* Waters designated for warm water game fish and associated food chains are required to exhibit appropriate levels of dissolved oxygen, temperature, and pH levels as well as comply with other parameters for the support of warm water aquatic life.

3. *Waterfowl, shorebirds and other water-oriented wildlife (3D):* Waters with this designation are required to exhibit physical, chemical, and biological characteristics supportive of these wildlife and all levels of their associated food chain.

4. *Agricultural water supply (4):* Waters designated for use as agricultural water supply (including irrigation and livestock watering) are required to be suitable for the irrigation of crops or as water for livestock. They are also required to meet general surface water quality criteria for TDS (salinity) and various metals such as lead and cadmium.

The *Cutler Dam and Middle Bear River TMDL Study* (UDWQ, 2010) and the *Lower Bear River TMDL Study* (UDWQ, 2002) were used as the primary sources of water quality information for this report. As such, most of the following information was summarized directly from those reports with limited modifications.

Cutler Dam and Middle Bear River TMDL

Both Cutler Reservoir and the Middle Bear River experience low dissolved oxygen (DO) conditions that impair the warm water fishery use (3B) as well as nuisance algal growth that exceeds literature thresholds identified to support recreational uses (Raschke, 1994). The identified pollutants of concern for Cutler Reservoir were total phosphorus with associated low dissolved oxygen (DO) as a consequence of nutrient loading. Pollutants of concern for the Middle Bear River were total phosphorus (TP) and total suspended solids (TSS). Phosphorous was the primary focus of the TMDL analysis because "management of the system as phosphorous-limited reduces the threat of blue-green algae while also reducing the concentration of total algae in the water column and thereby improving oxygen concentrations" (UDWQ, 2010).

The majority of regulated point sources in the Cutler Reservoir watershed are accounted for in separate TMDLs for other water bodies in the area. The remaining regulated point sources that were directly addressed by the Cutler Dam and Middle Bear River TMDL include the Logan Regional Wastewater Treatment Plant, the Fisheries Experiment Station, and storm water from MS4 permitted municipalities. Nonpoint sources are grouped into four major land use types and sources: 1) agriculture, 2) forest, 3) urban/suburban (including storm water not included in MS4 permitted discharges), and 4) miscellaneous or natural sources. All of these sources contribute to the water quality impairment in the reservoir and were allocated a load in the TMDL.

Load allocations were broken into allocations for the southern portion of Cutler Reservoir, the northern portion of Cutler Reservoir, and the Middle Bear River. Separate allocations were determined for the winter season and normal allocations for remainder of the year. Winter and normal load allocations identified for the Southern reservoir require a 61% reduction of phosphorous for the summer season and a 46% reduction for the winter season. Allocations for the Northern Reservoir require a summer reduction of 59% and a winter reduction of 53%. For the Middle Bear River, identified load allocations require a 68% summer and 62% winter reduction of total phosphorous from non-point sources.

Water flows downhill. Because many sources of pollution originate along tributaries and other water bodies within the watershed that have separate TMDL studies, the attainment of water quality endpoints for Cutler Reservoir and the Middle Bear River depend on the attainment of TMDL allocations identified in the Little Bear River TMDL (2000), the Spring Creek TMDL (2000), the Cub River TMDL (1997), and the Newton Creek TMDL (2004).

Lower Bear River and Tributaries TMDL

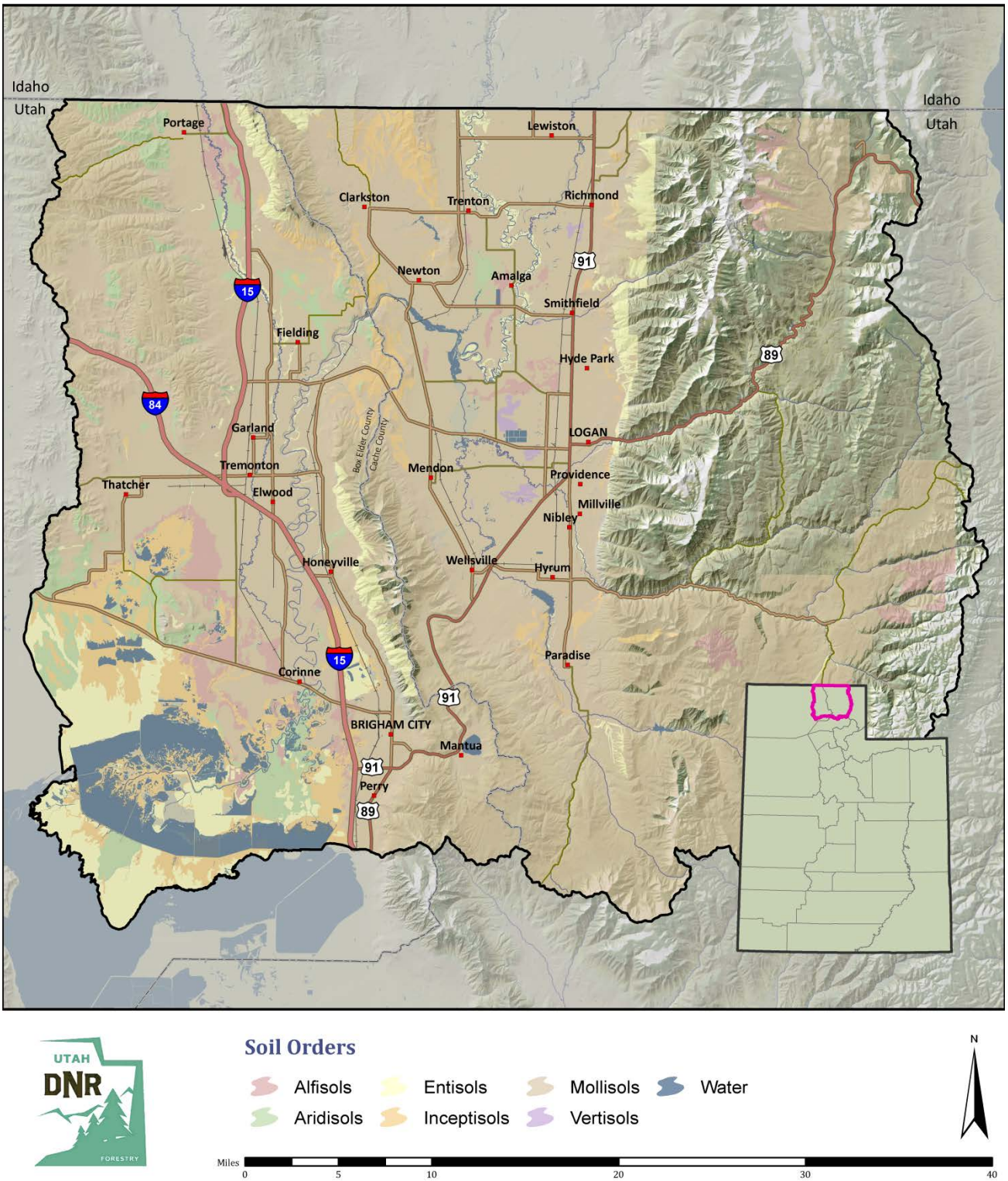
The Lower Bear River and Tributaries TMDL covers the main stem of the Bear River from Cutler Reservoir to the Bear River Bird Refuge. The designated beneficial uses of this section of the Bear River are the same as those listed for the Middle Bear River in the previous section. The main stem of the Lower Bear River was separated into two segments: (1) From Cutler Dam to the confluence with the Malad River and (2) from the Malad River confluence to the Bear River Migratory Bird Refuge and the Great Salt Lake. These river segments were both designated as not meeting designated beneficial use

standards for class 3B – warm water species of game fish. The primary pollutant of concern for both segments was total phosphorous (TP). Total suspended solids also listed as a significant pollutant that could impair fisheries as well as the value of the water for recreational users, but did not exceed state standards. Bacterial contamination also presents a health concern for recreational users, but was not assessed for the class 2 standards protecting recreational use.

The largest single source of total phosphorous into the Bear River below Cutler Dam is the Bear River itself (average 703 kg TP/day). Animal wastes from feeding operations are the second largest source, followed by stream bank erosion and irrigation return flows. Five permitted point sources of pollution were also identified at the time of the *Lower Bear River and Tributaries TMDL Stud*y. Of these, four were wastewater treatment facilities and one was an industrial source. Because nonpoint source loads represented the vast majority of the total sources of phosphorous, they became the primary focus of implementation strategies proposed to bring the river back into compliance with the state-established water quality standards.

It is important to note that significant changes have occurred since the Lower Bear River and Tributaries TMDL was completed in 2002. New information has suggested that there are more extensive systems of agricultural field drainage tiles and associated inflows to the Bear River than were previously identified. Population growth and additional industrial activities within the area may also have increased the relative contribution of point sources of pollution. Correspondingly, a new TMDL study is currently being conducted to update the analysis and better incorporate these factors). The new TMDL for the Lower Bear River is expected to be complete by the end of 2016 (Allred, 2015)**.** For the purposes of the Bear River Comprehensive Management Plan, it may be possible to obtain some of the data and information currently being under review for the 2016 TMDL on the lower Bear River.

Map 5: Soil Orders



3.5 Soils

Soils within the study area have evolved over time with climate, topography, hydrology, and biological forces that wore down and deposited parent materials from limestone, sandstone, quartzite, and dolomite to create fertile, productive soils (Cache County Resource Assessment, 2011). Soils in the study area were strongly influenced by Lake Bonneville. Soils in the valley bottoms formed primarily from transported alluvial sediments, deposited by rivers and streams (Cache County Soil Survey, 1974). As Lake Bonneville receded, deposition of mixed materials formed terraces at the base of surrounding mountains. As a result, soils in the valley bottoms tend to be fine textured and poorly drained, while foothills and terraces contain more coarse sediments (Cache County Soil Survey, 1974).

Soil data is incomplete for much of the high elevation mountain ranges, especially in the Bear River Range, but many areas are likely to consist of bedrock parent materials. It is, however, available for the most of the foothills and, most importantly, the valley bottoms through which the Bear River flows. Soil orders represent the most general level of classification in the USDA system of Soil Taxonomy and are defined by a single dominant characteristic such as prevalent vegetation, parent material, or climatic variables indicative of the processes under which they were formed (NRCS, 1999). This classification has been used here to provide a broad representation of the soils within the study area.

Mollisols

Mollisols are considered the soils of grassland ecosystems. They are characterized by a thick, dark surface horizon that has resulted from the long-term addition of organic materials derived from plant roots. Mollisols are among some of the most important and productive agricultural soils and are extensively used for this purpose. They occur where average annual precipitation typically exceeds 12 inches and are found mainly above 4400 feet in elevation (Boettinger, 2009).

Entisols

Entisols are soils of relatively recent origin that are characterized by great diversity in both environmental setting and land use. Many entisols are found in steep, rocky areas. However, the Entisols found in large river valleys can be very fertile and capable of supporting significant cropland and habitat. The central concept is that entisol soils developed from unconsolidated parent material. All soils that do not fit into one of the other 11 orders are considered Entisols. (Boettinger, 2009).

Inceptisols

Inceptisols are soils that exhibit minimal horizon development and are found on relatively young geomorphic surfaces. They are more developed than the Entisols described above, but still lack features characteristic of the other soil orders. Inceptisols are widely distributed and occur across a range of ecological settings. They are often found on fairly steep slopes, young geomorphic surfaces, and on resistant parent materials. A sizable percentage of Inceptisols are found in mountainous areas and are used for forestry, recreation, and watershed. (Boettinger, 2009)

Alfisols

Alfisols are moderately leached soils that have relatively high native fertility. These soils have mainly formed under forested vegetation conditions and have a subsurface horizon in which clays have accumulated. The combination of a generally favorable climate and high native fertility associated with Alfisols tends to represent productive soils for both agricultural and silvicultural use. However, soil horizons are strongly alkaline and vegetation within them generally consists of salt-tolerant grasses and shrubs in lower elevations and conifers at higher elevations. (Boettinger, 2009)

Aridisols

Aridisols are calcium carbonate containing soils found in arid regions that exhibit at least some subsurface horizon development. They are characterized by being dry most of the year with very limited leaching. Aridisols contain subsurface horizons in which clays, calcium carbonate, silica, salts, and/or gypsum have accumulated. Aridisols generally support drought-resistant vegetation such as sagebrush, saltbush and greasewood. Because of the dry climate in which they are found (generally less than 12 inches of annual precipitation), they are not generally used for agricultural production unless irrigation water is available.

3.6 Vegetation

Vegetative cover in the study area varies with climate, elevation, terrain, and soils as well as both historical and current land uses. From subalpine plant communities at higher elevations to the desert-shrub and mud flat communities in the lower reaches, the Bear River Basin encompasses many different vegetative zones. Along the main stem of the Bear River in Cache County, vegetation is dominated by agricultural crops and altered rangelands, but still contains some areas of natural and semi-natural vegetation characteristic of arid and semi-arid shrublands and grasslands.

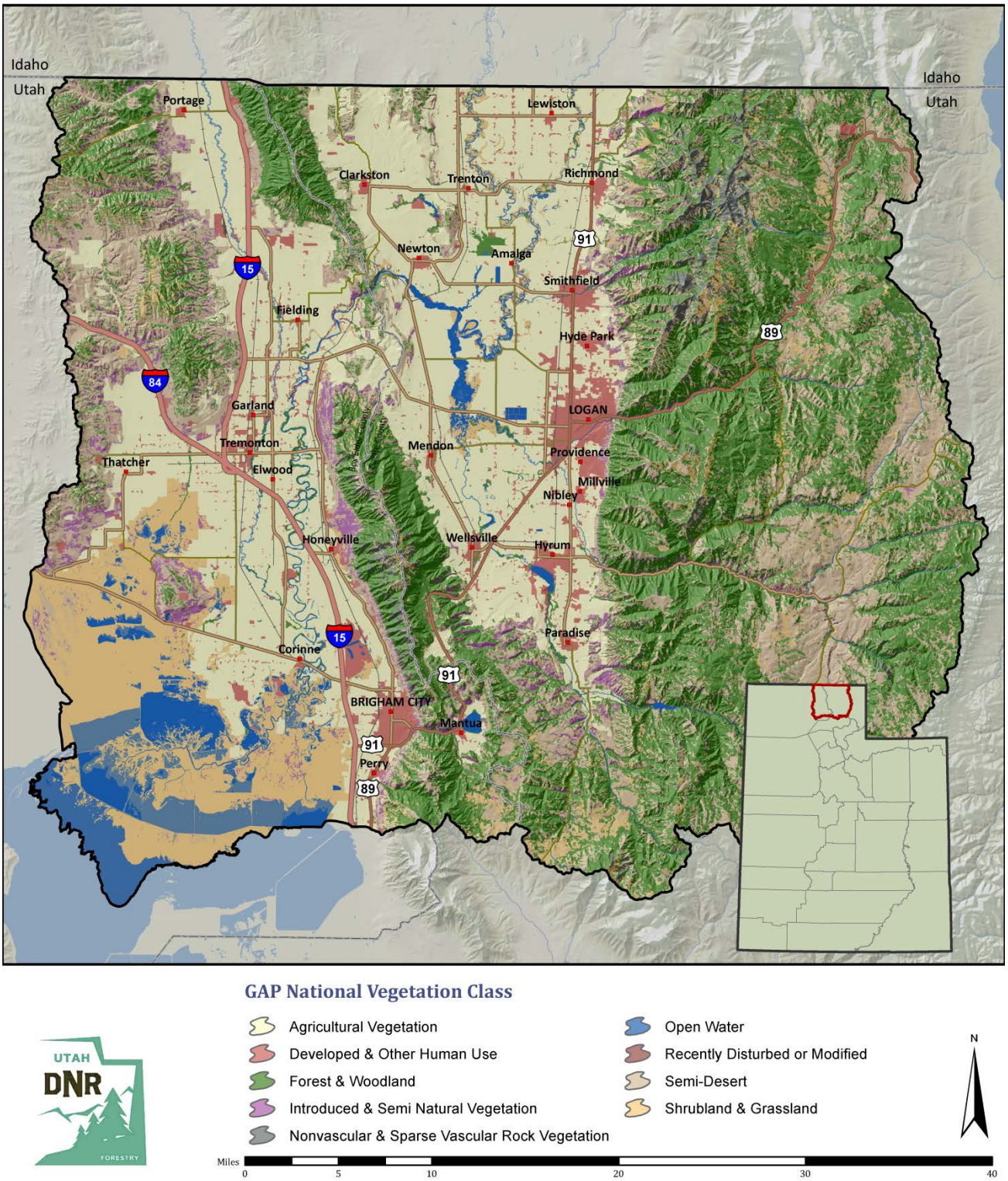
The use of ecoregions has become a fairly standard method of categorizing ecological variation across large landscapes. The two most common ecoregion delineations are the U.S. Forest Service Bailey Ecoregions and the Omernik Ecoregions used by the Environmental Protection Agency. However, "while ecoregions are applicable to regional and global representations, more local applications require a different approach in order to address ecoregion variances and understand differences between vegetation types" (Ramsey and West, 2009) At the other end of the spectrum, GAP vegetation data often provides a level of detail that may become overwhelming when applied across large areas of the landscape. In Utah, the major environmental determinants of vegetation are precipitation and temperature – both highly correlated with elevation. "Because of the great variation of elevation in Utah, the principle ecological distinction that has long been recognized is that of life zone" (Ramsey & West, 2009). Since elevation, temperature, and precipitation can all be modeled spatially, Ramsey and West were able to spatially depict the distribution of vegetative life zones across the state.

For the purposes of this study, the vegetative life zones identified in Rangeland Resources of Utah (Ramsey and West, 2009) will be used to provide an overview of the vegetation within the study area. Five of the seven vegetative life zones identified for the state of Utah are present in the study area, including subalpine, high mountain, mountain, upland, and semi-desert. One shortcoming of the zonal approach, however, is that some ecosystem types such as sand dunes, wet meadows, marshlands, and riparian areas do not easily fit into this structure (Ramsey and West, 2009). Since this report is primarily focused on lands along the Bear River, an additional section has been added to specifically address wetland and riparian vegetation along the Bear River Riparian Corridor. The more detailed GAP vegetation, land cover, and land use data has been mapped to illustrate the pattern of vegetation along the river as it flows from Cache Valley to the Great Salt Lake.

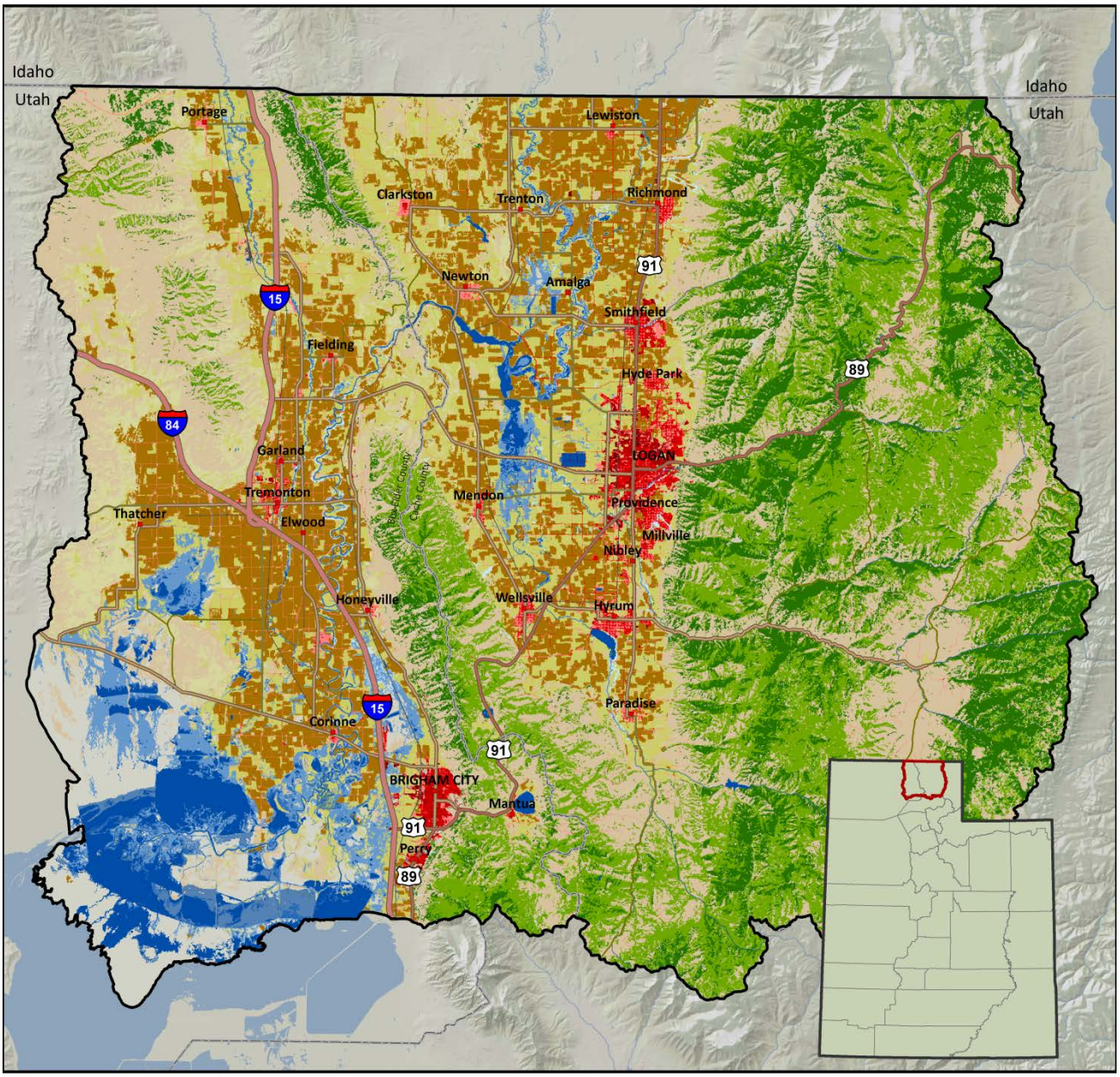
While vegetative communities have been broken down largely by elevation, many factors determine their occurrence. Transitions tend to be very subtle with significant intermixing of plant communities. Additionally, varied micro-environments created by even slight variances in climate, topography, soils, or hydrological regime allow patches of one vegetative zone to occur within other dominate zones. Human impacts also play a significant role in the vegetative cover of the landscape and, especially in lower lying areas, have altered or replaced the natural vegetation.

Map 6: Vegetative Life Zones

Map 7: Vegetation Classes (GAP National Vegetation Class)



Map 8: Land Cover



National Land Cover Dataset (2006)

- Open Water
- Developed Open Space
- Developed Low Intensity
- Developed Medium Intensity
- Developed High Intensity
- Barren Land (Rock/Sand/Clay)
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands

N

Miles 0 5 10 20 30 40

Subalpine and High Elevation Montane Zones

http://images.summitpost.org/original/560791.JPG

Subalpine and high mountain plant communities exist in the highest elevations of the watershed, generally from 7500 to 11000 feet above sea level. These communities represent the upper limit of the timber line and are characterized by very short growing seasons and very hardy plant species. While there are a number of different species present, the dominant land cover consists of intermixed areas of Spruce-Fir communities, bedrock scree in the highest areas with aspen, big sagebrush, and lodge-pole pine increasingly present in the lower elevations and more favorable aspects of this zone (Ramsey and West, 2009).

Medium and Low Elevation Montane Zones

http://images.summitpost.org/original/678782.JPG

The montane zone generally occurs between 6500 and 9000 feet in elevation and makes up the majority of the area in the Bear River Range. The climate in these areas is generally cool and moist during the winter and warm and dry in the summer. Aspen and Big sagebrush are increasingly dominant in this zone followed by oak brush, spruce-fir, and mixed conifer communities that slowly transition to bigtooth maple, pinion-juniper and tall shrub communities that dominate the low elevation mountains and foothills. Common understory plants include bearberry, currant, snowberry, serviceberry, mountain clover, mule's ear, mountain brome, and native grasses. The richness of vegetation in these areas supports a number of wildlife from large ungulates such as elk and mule deer to small ground-dwelling mammals. (Ramsey and West, 2009)

Uplands

Upland zones generally occur from 5000 to 8000 feet in elevation and are predominantly characterized by foothills around mountainous areas, lower elevation mountains – such as those at the Western edge of the study area – bluffs or escarpments, and high elevation valleys. These upland areas represent a broad portion of the landscape, especially in Cache Valley, and have therefore been split into two sub-categories: Foothills and Valley Bottoms.

Foothills

The foothills subcategory of the upland zone represents higher elevation upland habitats that frequently occur around the perimeter of mountainous areas, in lower elevation mountains, bluffs and escarpments. Dominant plant species include mountain brushes, maples, pinion-juniper communities and sagebrush with a smaller distribution of intermixed grasses and forbs. These areas often have a more moderate climate than surrounding low elevations as cold air flows down over them and sinks into the lower valleys. This zone is also associated with significant rural and urban development due to the more moderate temperatures, undulating topography, and the accessibility of water resources filtering down from higher elevations. Consequently many of these areas have been impacted or displaced by historical and present-day human land uses.

Valley Bottoms

While south-eastern Box Elder County is associated with the semi-desert plant communities described in the next section, Cache Valley is somewhat different. It has a slightly higher elevation and is relatively water-rich compared to the rest of the state due to higher levels of precipitation, several significant rivers and streams draining the Bear River Range, and high groundwater tables throughout many areas of the valley bottom. According to historical records, explorers and early settlers found abundant grasslands with little sagebrush in Cache Valley. In 1972, Range Scientists A.C. Hull and Mary Kay Hull

conducted a study in Cache Valley that identified 72 isolated areas that had escaped the heavy grazing experienced historically common throughout most of the watershed. The most dominant species identified was blue-bunch wheatgrass followed by other wheat grasses, basin wild rye, June grass, and various bluegrass species (Hull and Hull, 1972).

High water tables, abundant grasslands, and rich agricultural soils attracted settlers to the area and intensive grazing had a significant impact on the landscape. Grasslands quickly deteriorated and were replaced by sagebrush communities and cultivated farmland (Hull and Hull, 1972). The vast majority of land in the valley bottoms of Cache and Box Elder Counties is still utilized for agriculture, including both cultivated cropland and grazing. Cultivated crops include small grains, alfalfa, corn (mostly for silage), and limited row crops. Rangelands used for grazing have usually been seeded with mixtures of intermediate and crested wheat grasses but are also intermixed with semi-natural vegetation including sagebrush, rabbit-brush, and forbs. The predominance of agricultural uses in these areas leaves very little natural vegetation in place. Invasive species, such as cheat-grass and a number of noxious weeds are also present. Table 2 provides a list of noxious weeds as declared by the State of Utah and Cache and Box Elder Counties.

Semi-Desert Zone

The semi-desert vegetative life zone occurs from approximately 4000 to 6500 feet in elevation and is generally characterized by lower levels of rainfall and relatively flat topography. Dominant vegetation includes sagebrush, salt desert shrub, and grasses. Various types of invasive species such as cheat-grass, Russian olive, and tamarisk also comprise a significant portion of the vegetation in this zone. As with the upland zone, there is considerable difference between pre-settlement vegetation and what exists today. Agricultural and grazing lands facilitated by irrigation make up a considerable portion of these areas. Residential development is also significant in some areas. Overall, it is likely that these areas have a much lower biodiversity of both plant and animal species than would have naturally occurred in pre-settlement vegetative communities.

Wetland and Riparian Zones

Riparian zones occur at all elevations throughout the watershed. Despite making up an extremely small portion of the land base, riparian areas generally have a much higher biodiversity than other areas of the landscape. In dry areas – Utah is the second driest state in the nation – these wetland and riparian areas have a heightened importance due to their scarcity. While riparian zones are important throughout the study area, this section specifically addresses lowland riparian areas (generally below 5500 feet).

Along the Main Stem of the Bear River

Lowland riparian areas in the West are typically narrow bands of trees—predominantly cottonwoods—and shrubs surrounded by uplands of shorter vegetation (Knopf et al. 1988, Montgomery 1996). Principal woody species found in lowland riparian habitats in Cache and Box Elder County include cottonwood, hackberry, squaw-bush, box elder, red twig dogwood, and various willow species (DWR, 2005). Invasive species such as salt cedar (Tamarix sp.) and Russian olive (Elaeagnus angustifolia) are increasingly present in many areas (DWQ, 2010).

http://www.panoramio.com/photo/2221414

The flat relief, low stream gradients, and silty (former lakebed) soils of the Bear River corridor through most of Cache Valley and Box Elder County have resulted in a complex, meandering river channel. As the river changed course over the years, previous channels and oxbows were partially cut off or completely abandoned by the main river channel, creating significant remnant wetlands, most of which are still hydrologically connected to the river. This complex system, as a whole, may best be described as a riparian ecosystem incorporating wetlands, ponds, flowing waters, and uplands within the 100 year flood plain of the river (Hansen, 1991). Such riverine systems often support very diverse vegetative communities that represent important corridors for wildlife and cycle water, sediment, food, and nutrients (Emerson and Hooker, 2011).

Riparian areas are often associated with fertile soils, abundant water, and aesthetic allure that have long put riverine ecosystems in competition with agriculture, grazing, and urban development. The Bear River is no different. As development occurred in the region, many sites near the river were cleared and leveled to support agricultural activities (Denton, 2007). Some wetlands have been drained by networks of ditches and drain tiles, employed to improve land for grazing and agriculture. In many areas, especially in Box Elder County, agricultural lands are cultivated nearly to the river's edge.

Although significant effects occurred prior to control over livestock grazing on public lands, recent research indicates that poorly managed livestock remains a key factor in the degradation of riparian ecosystems (Belsky et al., 1999). Livestock grazing can be compatible with riparian systems, provided that maintenance of ecological function is included as a management objective and riparian systems are kept intact (Lucas et al., 2004). In addition, as in other vegetation communities, many of the adverse effects of livestock grazing can be alleviated by manipulating the timing, intensity, and the duration of grazing (Clary and Webster, 1989; Elmore and Kauffman, 1994).

Existing wetlands within the riparian ecosystem of the Bear River are often dominated by networks of ponds and wetland vegetation typical of oxbow wetlands, emergent marsh-type vegetation, and wet meadows. Forested wetlands occur where willow, poplar, box elder, and other species are found. Wetland vegetation is highly dependent on water availability, inundation period, and topography, which can vary widely in riparian environments (Emerson and Hooker, 2011). Both irrigation return flows and natural springs that emerge from the steeper sides of larger flat bottomed ravine create small wetland areas dispersed along the river's flood plain. The combination of multiple types of wetland systems intertwined with upland areas (both semi-natural and agricultural) and open water tends to make riverine environments some of the most diverse in terms of both flora and fauna (USFWS, 2014).

A plant survey has been done for the Morton section of the Bear River Bottoms in Cache Valley (BRLC, 2012). This property is owned by PacifiCorp and managed by the Bear River Land Conservancy. The results of that survey are provided in Table 1 as an example of the types of vegetation that may be encountered in these sections of the river. Only those making up more than .1% of the total land cover were included. Plant species listed in bold are designated as noxious in the State of Utah or in other

states as identified in the table. Other noxious and/or invasive species known to occur along the Bear River include purple loosestrife, goats rue, poison hemlock, white-top, and medusa head rye.

Table 1: Plant Species found at Morton Section of Bear River Bottoms

Common Name	Nativity	Plant Type	Notes	% Cover
Reed Canarygrass	Native	Graminoid		52.7
Russian Olive	**Introduced**	**Tree**	**Noxious in some states**	**10.1**
Coyote (Sandbar) Willow	Native	Shrub		9.7
Hardstem Bulrush	Native	Graminoid		6.5
Salt Cedar (Tamarisk)	**Introduced**	**Tree**	**Noxious in Utah**	**3.9**
Cheatgrass	Introduced	Graminoid	Weedy	2.6
Broadleaf Cattail	Native	Forb/herb		1.7
Foxtail Barley	Native	Graminoid		1.6
Black Hawthorn	Native	Tree		1
Peach leaf Willow	Native	Tree		0.7
Mixed Grass Species	Varies	Graminoid		0.5
Geyer Willow	Native	Tree		0.3
Rough Cocklebur	Native	Forb/herb		0.3
Canada Thistle	**Introduced**	**Forb/herb**	**Noxious in Utah**	**0.2**
Common Reed (Phragmites)	Varies	Graminoid		0.2
Fuller's Teasel	**Introduced**	**Forb/herb**	**Noxious in some states**	**0.2**
Narrow leaf Cottonwood	Native	Tree		0.2
Quackgrass	**Introduced**	**Graminoid**	**Noxious in Utah**	**0.2**
Yellow Rabbitbrush	Native	Shrub		0.2
American Licorice	Native	Forb/herb	Weedy	0.1
Biennial Wormwood	Introduced	Forb/herb	Weedy	0.1
Bull thistle	**Introduced**	**Forb/herb**	**Noxious in some states**	**0.1**
Common Yarrow	Native	Forb/herb		0.1
Crack Willow	Introduced	Tree		0.1
Curly Cup Gumweed	Native	Forb/herb		0.1
Inland Saltgrass	Native	Graminoid		0.1
Fremont Cottonwood	Native	Tree		0.1
Poison Hemlock	**Introduced**	**Forb/herb**	**Noxious in Utah**	**0.1**
Povertyweed	Native	Forb/herb		0.1
Tall Wheatgrass	Introduced	Graminoid		0.1
Western Aster	Native	Forb/herb		0.1
Willow spp.	Varies	Tree		0.1
Houndstongue	**Introduced**	**Forb/herb**	**Noxious in Utah**	**0**
White Bryony	**Introduced**	**Forb/herb**	**Noxious in some states**	**0**

Cutler Marsh and Reservoir

http://www.panoramio.com/photo/2221414

Surrounding Cutler Reservoir, lands owned by PacifiCorp are managed to protect wildlife habitat that supports a variety of waterfowl and other water-dependent bird species (PacifiCorp, 2013). The wetland vegetation is a mixture of emergent marsh dominated by cattail and common reed (Phragmites). Freshwater wet meadows are dominated by hardstem bulrush and Baltic rush (Denton, 2007). As part of PacifiCorp's management plan, agriculture and grazing activities are allowed in some areas, but vegetated buffer zones and bank stabilization projects have been established to protect habitat and water resources (PacifiCorp, 2013). Various types of vegetation including intermediate wheatgrass and various shrub species are used to provide both livestock forage and maintain vegetative cover. Cultivated food plots that provide forage for various wildlife species have also been incorporated (PacifiCorp, 2013).

Despite management efforts, invasive species do comprise a significant portion of the vegetation surrounding Cutler Reservoir. Emergent marsh species such as reed canary grass, common reed, and broadleaf cattail include both native and non-native phenotypes that can be difficult to distinguish, but become invasive or undesirable where they exist as large monocultures. The threat posed by invasive species has been exacerbated by altered hydrological regimes (Glen & Nagler, 2005 and Stromberg et al, 2007). Refer to Table 2 for a list of noxious and invasive species, highlighting some of those that are likely to be found along the margins of the Bear River and Cutler Reservoir.

The Bear River Delta and Migratory Bird Refuge

As the river nears the bird refuge, it enters the desert shrub vegetative zone. Many plant communities in this area exist on mudflats that fill with water during wet periods of the year and are left dry the rest of the time. Saline conditions require plants with a high salt tolerance such as greasewood, salt grass, and pickle weed. As native vegetation has been displaced or died out due to changes in water flows,

increasingly saline soils, and a lower water table, significant portions of this stretch have become dominated by the invasive species tamarisk (Olson et al., 2004).

There are significant wetlands located within the periphery of the desert shrub and mud flat communities that make up the Bear River delta. Many of the historic wetlands that would have likely been present along the floodplain pre-settlement have disappeared as upstream demands for water resources have increased. Some of the more significant wetlands that do currently exist in the area are the man-made wetlands that make up the Bear River Migratory Bird Refuge. The refuge was established in 1926 to provide feeding and breeding habitat for waterfowl and migratory bird species and to help mitigate the environmental impact of the shrinking Bear River delta (USFWS, 2013). The Fish and Wildlife Service manages some 41,000 acres of wetlands in addition to associated upland habitats that make up a total of almost 80,000 total acres (USFWS, 2015). Wetlands in the refuge as well as surrounding areas include deep-water submergent and emergent wetlands, shallow emergent wetlands, mud flats, and playas that support a variety aquatic, wetland, and riparian vegetation. As in cutler marsh, invasive species, including Phragmites, represent a significant threat to many of these systems.

Non-native and Invasive Species

The Division of Forestry, Fire and State Lands actively engages with partner organizations to control noxious and invasive species associated with sovereign lands resources. Table 2 lists noxious species declared by the State of Utah or the counties. Those species in bold are listed as county priorities and/or known to exist along the Bear River Corridor.

Table 2: Noxious Weeds declared by the State of Utah, Cache and BE Counties		
Bermudagrass (cynodon dactylon)	Class B	Statewide
Black henbane (hyoscyamus niger)	Class A	Statewide
Broad Leaved Peppergrass (lepidium latifolium)	**Class B**	**Statewide**
Canada thistle (cirsium arvense)	**Class C**	**Statewide**
Dalmation Toadflax	Class B	Statewide
Diffuse knapweed (centaurea diffusa)	Class A	Statewide
Dyers woad (isatis tinctoria L)	**Class B**	**Statewide**
Field bindweed (convolvulus arvensis)	Class C	Statewide
Goatsrue (Galega officinalis)	**Local**	**Cache County**
Hoary cress (cardaria drabe)	**Class B**	**Statewide**
Houndstongue (cynoglossum officinale)	**Class C**	**Statewide**
Perrendial Sorghum/Johnsongrass (sorghum halepense)	Class A	Statewide
Leafy spurge (euphorbia esula)	**Class A**	**Statewide**
Medusahead (taeniatherum caput-medusae)	**Class A**	**Statewide**
Musk thistle (carduus mutans)	**Class B**	**Statewide**
Oxeye Daisy (chrysanthemum leucanthemum)	Class A	Statewide
Perennial sorghum (sorghum halepense & sorghum almum)	Class A	Statewide
Poison Hemlock (Conium maculatum)	**Class B**	**Statewide**
Punctureveine (Tribulus terrestris)	**Local**	**Cache & BE**
Purple loosestrife (lythrum salicaria L)	**Class A**	**Statewide**
Quackgrass (agropyron repens)	Class C	Statewide
Russian knapweed (centaurea repens)	Class B	Statewide
Salt Cedar (onopordum acanthium)	**Class C**	**Statewide**
Scotch thistle (onopordum acanthium)	Class B	Statewide
Spotted knapweed (centaurea maculosa)	Class A	Statewide
Squarrose knapweed (centaurea squarrosa)	Class A	Statewide
St. Johnswort (hypericum perforatum)	Class A	Statewide
Yellow starthistle (centaurea solstitialis)	**Class A**	**Statewide**
Yellow toadflax (linaria vulgaris Mill.)	Class A	Statewide

3.7 Wildlife Habitat

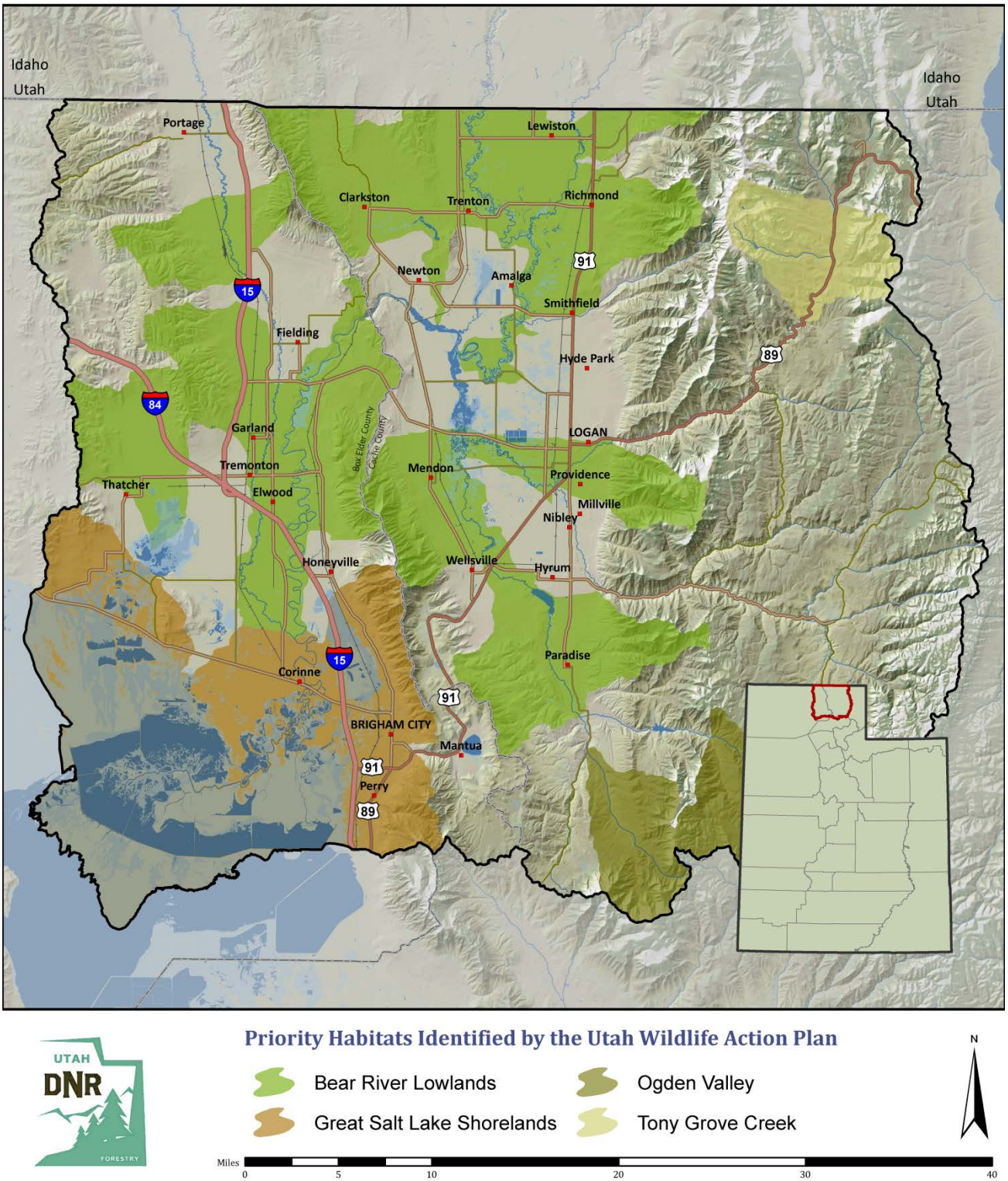
At a regional scale, the geographic location of the Bear River Basin provides an important terrestrial link between the Greater Yellowstone Ecosystem in the Central Rocky Mountains, the Uintah Mountains in the Southern Rocky Mountains and the Great Salt Lake Ecosystem in the Great Basin. The upper Bear River from the Uintah Mountains to Central Idaho is located along the path of the central flyway

migratory corridor while the lower Bear River, through Cache Valley and Box Elder County, provides an important stopover for migrating birds in the Pacific flyway. Topographical and climatic variation within the Bear River Watershed creates a wide range of habitat types for wildlife. High elevation mountain ranges are habitat for deer, elk and moose, along with a variety of upland birds and small mammals. Foothills and upland areas provide important winter range for large animals in addition to supporting a variety of their own avian and small mammal species. Wetlands and riparian areas throughout the landscape represent some of the richest habitat in the state, yet they make up a very small percentage of our land base. According to the Division of Wildlife Resources, lowland riparian areas make up less than 1% of the total land area in Utah.

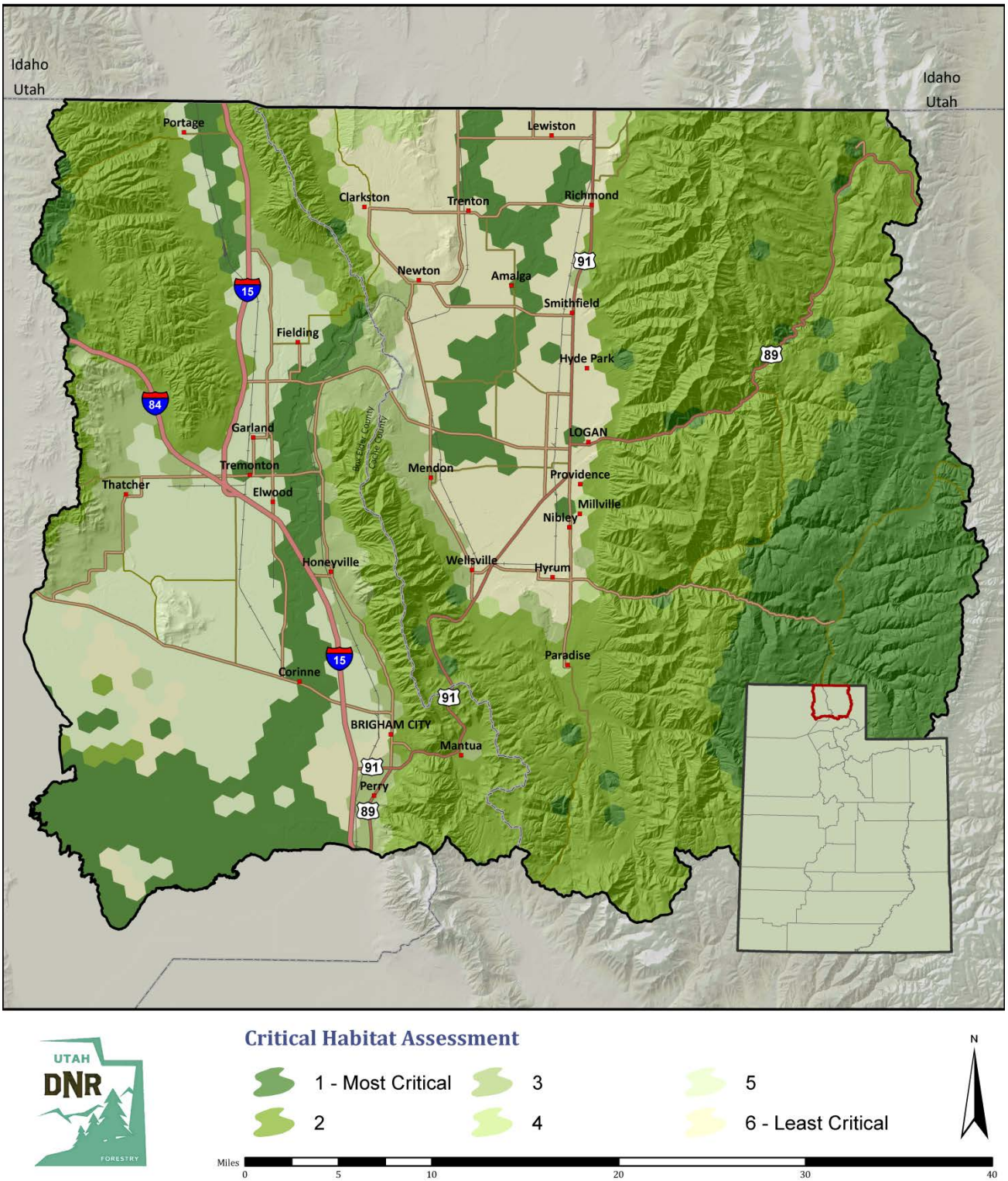
The importance of the Bear River corridor as significant and critical wildlife habitat is evident through the various designations that have been assigned to areas along the river by both private and public entities. There are two national wildlife refuges and one waterfowl production area along the Bear River in Utah and Idaho. The Bear River corridor has been identified as a conservation focus area by the Nature Conservancy due to its importance for both human and wildlife communities. The BRMBR as well as cutler marsh and the Amalga barrens have been designated important bird areas of global significance by the Audubon Society. The Utah Division of Wildlife Resources identifies lowland riparian habitats as one of the rarest and most threatened habitats in the state of Utah (UDWR – 2005). The Western Governors' Association critical habitat assessment tool rates the Bear River Corridor in the second highest category of critical habitats in the Western United States (see Map 10). The Great Salt Lake, an ecosystem of global importance, receives the majority of its water from the Bear River (FFSL, 2013). Without this water, much of the shoreline habitat in the Great Salt Lake ecosystem could potentially be significantly altered if not lost.

While the habitat descriptions in this section have been separated into different categories, it is important to recognize that they are better represented as a mosaic of habitats within the larger landscape. The interaction among these habitats is at least as important as the attributes of each individual type. Furthermore, many species rely on multiple habitat types to support different life stages and activities. One example of such a species is the long-billed curlew, which requires upland habitats for nesting but also requires nearby wetland areas to provide forage (Saalfield et al., 2010).

Map 9: 2005 Utah Wildlife Action Plan Priority



Map 10: Western Governors Association (WGA) Critical Habitat Assessment



Upland Habitats in the Valley Bottoms

Since the focus of this study is along the river corridor, this section specifically addresses upland habitat in the valley bottoms and the lowland riparian, wetland, and aquatic habitats along the Bear River. As explained in the vegetation section of this report, the valley bottoms in Cache and Box Elder County have been highly altered to support agricultural production and, to a more limited extent, residential development. Agricultural lands have displaced the vast majority of native vegetation and much of the associated habitat in these areas. However, agricultural lands themselves are used by a variety of different wildlife species and often provide an important source of forage. One example is provided by the ring-necked pheasant. While pheasants are an introduced species, they have become an important upland game bird in Utah and are almost always found in close proximity to irrigated farmland.

Bluffs overlooking the floodplain are largely devoid of trees due to clearing for agricultural uses. Where trees do remain along the river, they tend to be sparsely distributed with few shrub species in the understory, making connectivity among patches of vegetation a frequent problem. Such isolated patches present a significant amount of edge habitat, which is a benefit to some species but increases the rate of predation for others.

Wetland Habitats

The Bear River supports significant and diverse wetland habitats. In this section, wetlands have been grouped into three primary categories: oxbows and riverine wetlands along the main stem of the Bear River, wetlands associated with Cutler Marsh and Reservoir, and wetlands associated with the Bear River delta and the Bear River Migratory Bird Refuge.

Along the Bear River

The Utah Division of Wildlife Resources identifies lowland riparian habitats as one of the most rare and threatened habitats in the State of Utah (DWR, 2005). The lowland riparian areas surrounding the Bear River play an important role in the lifecycle of various bird species. Many species use these areas as a stopover, breeding habitat, or as part of their winter range. It is a migration route for Neotropical birds that provides resting habitat and foraging areas (USFWS, 2013). Partners in flight reported the greatest songbird diversity in Utah at a banding station in the area (Denton, 2007). There are also abundant populations of predatory birds such as the great blue heron, osprey, and bald eagles.

The complexity of riverine ecosystems with their interwoven upland, wetland, and open water habitats create very diverse communities with respect to both flora and fauna (USFWS, 2013). Linear features such as rivers, streams, and associated riparian areas that spread upward through a watershed provide a network of corridors that have become increasingly important as many of areas of the wider landscape have become fragmented by infrastructure and development.

There are many different types of wildlife that use these areas including reptiles and amphibians, small mammals such as beavers and foxes, and a wide variety of avian species. Larger species including Mule Deer are also known to inhabit the river bottoms and can frequently be observed feeding in nearby upland areas or agricultural fields. The Morton section of the Bear River Bottoms in Cache Valley represents one site that has been the subject of recent studies conducted by faculty and students at Utah State University. As part of the Bear River Land Conservancy's baseline study and management plan, they included the following list of avian species. This information is presented in Table 3 to provide an example of the species that may be found in similar areas along the river.

Table 3: Avian Species Identified in Morton Section of BR Bottoms
(May-July 2010 & 2011)

American Avocet	Cedar Waxwing	Ring-necked Pheasant
American Coot	Double-crested Cormorant	Northern Flicker
American Crow	Downy Woodpecker	Red-tailed Hawk
American Goldfinch	Eastern Kingbird	Red-winged Blackbird
American Kestrel	Eurasian Collared-Dove	Sandhill Crane
American Robin	Eurasian Starling	Savannah Sparrow
American White Pelican	Franklin's Gull	Snowy Egret
Barn Swallow	Gadwall	Sora
Black-billed Magpie	Great-horned Owl	Song Sparrow
Black-capped Chickadee	Grasshopper Sparrow	Spotted Sandpiper
Black-crowned Night Heron	Great Blue Heron	Swainson's Hawk
Belted Kingfisher	Green-winged Teal	Tree Sparrow
Brown-headed Cowbird	House Sparrow	Violet-green Swallow
Black-headed Grosbeak	Killdeer	Western Grebe
Bank Swallow	Lazuli Bunting	Western Kingbird
Black-necked Stilt	Long billed curlew	Western Meadowlark
Brewer's Blackbird	Mallard	Western Tanager
Broad-tailed Hummingbird	Marsh Wren	White-faced Ibis
Bullock's Oriole	Mourning Dove	Willow Flycatcher
Canada Goose	Northern Pintail	Willet
California Gull	Northern Shoveler	Wilson's Phalarope
Common Barn Owl	N. Rough-winged Swallow	Wilson's Snipe
Cinnamon Teal	Ring-billed Gull	Yellow Warbler
Clark's Grebe	Redhead	Yellow-headed Blackbird
Cliff Swallow	Rough-legged Hawk	Yellow-rumped Warbler
Common Raven	Rock Dove	
Common Yellowthroat	Rock Pigeon	

Cutler Reservoir and Marsh

The wetlands in and around Cutler Reservoir are home to many species of reptiles, amphibians, and birds. Reptiles found in both uplands and wetlands of Cache Valley include the rubber boa (Charina bottae) and western yellow-bellied racer (Clouber constrictor). Amphibians such as the boreal chorus frog (Pseudacris triseriata maculata) and bullfrog (Rana cates) commonly occur in wetlands at lower elevations in the valley.

Cutler Reservoir provides nesting and feeding habitat for a wide variety of bird species (Table 2.8). A great blue heron rookery and an ibis rookery are also located at the south end of the marsh. The heron rookery near Mendon Road was first documented in 1945. The ibis rookery, which is on the east side of Cutler Reservoir, was home to over 5% of the world's ibis population in 2006. It is also home to populations of Franklin's gulls and occasional flocks of snowy and cattle egrets. Ospreys were observed on a successful nest site near Benson Marina during 2007.

Because of its use by the American white pelican (a state listed sensitive species), American avocets, black-necked stilts, and its status as a gathering site for wading birds, Cutler Reservoir has been designated as an important bird area (IBA) of global significance by the Utah Audubon Society (Utah Audubon Society 2004). PacifiCorp has designated the south end of the marsh, commonly known as the Wetlands Maze, for use by wildlife. As part of their relicensing agreement for Cutler Dam, PacifiCorp has engaged in habitat improvement and recreation programs around Cutler Reservoir.

The Bear River Delta and Migratory Bird Refuge

Desert-shrub, mudflat and wetlands along the historic floodplain and delta of the lower Bear River create a mosaic of habitats that support a wide diversity of shorebirds such as American avocets, black-necked stilts, and sandpipers. The Bear River bird refuge hosts over 200 species of birds that use that area at different times of the year. According to the Box Elder County wetlands management plan, approximately 30 percent of migratory waterfowl in the Pacific flyway use the refuge use the area as one of their resting stops. Table 4 lists the sixteen priority species identified by the Bear River Migratory Bird Refuge. Providing habitat for these species drives all management activities at the refuge.

Table 4: Bear River Migratory Bird Refuge Priority Species

Rank	Common name	Scientific Name	Life Cycle Activity
1	American Avocet	Recurvirostra americana	Breeding/Migration
2	Cinnamon Teal	Anas cyanoptera	Breeding
3	Black-necked Stilt	Himantopus mexicanus	Breeding
4	White-faced Ibis	Plegadis chihi	Breeding
5	Shorebirds	various species	Migration
6	Waterfowl	various species	Migration
7	Tundra Swan	Cygnus columbianus	Staging/Migration
8	Snowy Plover	Charadrius alexandrinus	Breeding
9	Marbled Godwit	Limosa fedoa	Staging/Migration
10	Long-billed Curlew	Numenius americanus	Breeding
11	American White Pelican	Pelecanus erythrorhynchos	Forage
12	Redhead	Aythya americana	Breeding
13	Wilson's Phalarope	Phalaropus tricolor	Staging/Migration
14	Long-billed Dowitcher	Limnodromus scolopaceus	Staging/Migration
15	Franklin's Gull	Larus pipixcan	Breeding
16	Black Tern	Chlidonias niger	Breeding/Migration

Aquatic Habitats

The Middle Bear River and Cutler Reservoir are highly altered systems few native fisheries remaining in most areas. Historic populations in the Middle Bear River included Bonneville cutthroat and red side shiners, but these species are no longer found. Water quality is identified as the primary reason for the population shift in the fishery (DWQ, 2010). Changes in flow, sedimentation, and diversions associated with historic agricultural activities are considered the most probable causes of the degradation in the fishery. These factors are exacerbated by the constant disturbance of bottom sediments by large populations of carp in both the river and reservoir.

Cutler Dam and the Middle Bear River Fisheries

In 2005 and 2006, 14 species of game and non-game species were sampled in Cutler Reservoir and the Middle Bear River (Budy et al, 2006). The species found in Cutler Reservoir included largemouth bass,

smallmouth bass, common carp, bluegill sunfish, green sunfish, brown trout, rainbow trout, Utah sucker, fathead minnow, channel catfish, walleye, suckers, black crappie, black bullheads, and fathead minnows (Budy et al. 2006). Overall, the abundance and diversity of fish species was found to be high throughout Cutler Reservoir. Carp comprised almost 70% of the total fish biomass, and other dominant species include walleye and catfish.

In lower reaches of the Bear River just upstream of Cutler Reservoir, largemouth bass, walleye, channel catfish, black crappie, bluegill sunfish, green sunfish, fathead minnows, and carp have been found (Budy et al, 2006). Near the Utah-Idaho border, both lower quantities and a lower diversity of fish species were found. Those that were captured included largemouth and smallmouth bass, walleye, channel catfish, green sunfish, Utah sucker, fathead minnow, and common carp (Budy et al, 2006).

Lower Bear River Fisheries

There is very little current information regarding fish species present below Cutler dam. A 1962-1965 fish survey identified twelve species of fish present. Walleye and largemouth bass were found directly below the dam with a transition downstream to channel catfish, common carp, and suckers (Bangerter, 1965). Surveys completed in 1990 as part of Cutler Dam's relicensing found nine species of fish. Fathead minnows made up 90% of the catch followed by carp (8%) and channel catfish (1%). In 1999, the USGS sampled species in the Bear River near Corinne and found only five species, two of which were carp. Gizzard shad, which had not been noted in previous studies, made up 57% of the catch, followed by 40% carp, 1.5% channel catfish, and 1.5% walleye (Albano and Giddings, 2007). Thirty four species of benthic invertebrates were also collected by the USGS. However, 90% were Hydropsyches, Chironomids, or Naidides that serve as indicators of poor water quality (Albano and Giddings, 2007). Since the USGS only sampled lower reaches of the river, it seems possible that other fish species may be present further upstream, especially in the reach directly below Cutler Dam. The Division of Wildlife Resources is planning fish surveys along this section of the river within the next couple of years.

Threatened, Endangered, or Sensitive Species

Table 5 on the following page provides a list of sensitive wildlife species that have historically been observed or are currently known to exist in Cache and/or Box Elder County. This list includes both federally listed "threatened," "endangered" or "candidate" species as well as the State of Utah's designated "conservation species" or "species of concern."

Table 5: Threatened, Endangered and Sensitive Species

Common Name	Scientific Name	Status	County
American White Pelican	Peleacanus erythrorhynchos	SPC	Both
Bald Eagle	Haliaeetus leucocepahlus	SPC	Both
Black Swift	Cypseloides niger	SPC	Cache
Bluehead Sucker	Catostomus discobolus	CS	Both
Bobolink	Dolichonyx oryzivorus	SPC	Both
Bonneville Cutthroat Trout	Oncorhynchus clarkii Utah	CS	Both
Brown (Grizzly) Bear	Ursus arctos	S-ESA	Cache
Burrowing Owl	Athene cunicularia	SPC	Both
California Floater	Anondonta californensis	SPC	Both
Canada Lynx	Lynx canadensis	S-ESA	Cache
Deseret Mountainsnell	Oreohelix peripherica	SPC	Both
Ferruginous Hawk	Buteo regalis	SPC	Both
Fringed Myotis	Myotis thysanodes	SPC	Cache
Grasshopper Sparrow	Ammodramus savannarum	SPC	Both
Gray Wolf	Canis lupus	S-ESA	Box Elder
Great Plains Toad	Bufo cognatus	SPC	Both
Greater Sage Grouse	Centrocerus ursophasianus	S-ESA	Both
June Sucker	Chasmistes liorus	S-ESA	Box Elder
Kit Fox	Vulpes macrotis	SPC	Box Elder
Lahontant Cutthroat Trout	Oncorhynchus clarkii hensawi	S-ESA	Box Elder
Least Chub	Iotichthys phlegethontis	S-ESA, CS	Box Elder
Lewis's Woodpecker	Melanerpes lewis	SPC	Both
Long-Billed Curlew	Numenius americanus	SPC	Both
Lyrate Mountainsnell	Oreohelix haydeni	SPC	Both
Mountain Plover	Charadrius montanus	SPC	Box Elder
Northern Goshawk	Accipiter Gentilis	CS	Both
Northwest Bonneville Pyrg	Pyrgulopsis variegata	SPC	Box Elder
Preble's Shrew	Sorex Preblei	SPC	Box Elder
Pygmy Rabbit	Brachylagus idahoensis	SPC	Both
Sharp Tailed Grouse	Typmpanuchus phasianellus	SPC	Both
Short Eared Owl	Asio flammeus	SPC	Both
Three-Toed Woodpecker	Picoides tridactylus	SPC	Cache
Townsends Big-Eared Bat	Corynorhinus townsendii	SPC	Both
Utah Physa	Physella utahensis	SPC	Box Elder
Western Pearlshell	Magaritifera falcata	SPC	Box Elder
Western Red Bat	Lasiurus Blossevillii	SPC	Cache
Western Toad	Bufo boreas	SPC	Box Elder
Yellow Billed Cuckoo	Coccyzus americanus	S-ESA	Both
Yellowstone Cutthroat Trout	Oncorhynchus clarkii bouvieri	SPC	Box Elder

Status Definitions

S-ESA Federally-listed or candidate species under the Endangered Species Act.

SPC Wildlife species of concern.

CS Species with Special management under Conservation Agreement

Section 4. Human and Socio-Cultural Attributes

4.1 History and Culture

Native American Inhabitants

Archaeological evidence suggests that the earliest humans, referred to as paleo-indians, migrated into the region as the climate warmed following the last ice age, some 12,000 years ago (Simms, 1990). These original inhabitants would have been largely nomadic hunters and gatherers drawn to the relative abundance of game species along shorelines, river deltas and riparian corridors. As climatic conditions continued to dry and warm, there was a gradual but definite shift in settlement patterns beginning approximately 8,000 years ago and continuing until approximately 2,500 years ago, during which time it has been suggested that the semi-permanent occupation of villages began in the region (USFWS, 2012).

While evidence suggests that the Bear River Delta and the shoreline of the Great Salt Lake had been occupied for several thousand years, the majority of documented sites are from approximately 1500 years ago (Simms, 1990). It would have been around this time that the Fremont people began to settle the Bear River Drainage and establish more permanent settlements. Fremont subsistence, although variable, would have likely included the cultivation of corn, beans, and squash in addition to hunting and gathering activities (USFWS, 2012). The Fremont inhabited the basin from the fourth to the fourteenth centuries, at which point the archaeological record largely disappears (USFWS, 2012).

Whether the Fremont people were displaced or integrated into other groups, the Fremont culture was replaced by the Shoshone and Bannock tribes that were living in the area when the first Trappers arrived in the Early 1800s (USFWS, 2012).

Trappers and "Mountain Men"

The exploration of the Western United States and much of Utah was promoted by the quest for furs, land, and for a water passage through the Great Basin (Cline, 1963). The first documented European to enter the region was fur trapper Robert Stuart in 1812 (USFWS, 2012), who was reportedly informed of the abundance of Beaver in the area by a group of trappers from the American Fur Company who had entered the Bear River Basin via the Portneuf River in 1811 (Denton, 2007). With the high price of Beaver pelts, word spread quickly among trappers following Stuart's report. During the 1820s and 1830s, several trapping parties including Peter Skene Ogden and the Hudson Bay Company, the

Northwest Fur Company, the American Fur Company, and the Ashley-Henry Company were active along the Bear River (Denton, 2007). It was also during this period that Jim Bridger made his famed trip down the Bear River to the Great Salt Lake (Alter, 1947), though historical records seem to indicate he made the trip on horseback rather than in a bullboat (Crampton and Madsen, 1975).

The early trappers were organized around the rendezvous system, meeting periodically to deliver their hides and resupply without having to venture far from the areas in which they were trapping. The main rendezvous was in Cache Valley in 1826 and 1831 and at Bear Lake in 1827 and 1828 (Crampton and Madsen, 1975). While it was given various names in the early days of its exploration, the Bear River was named by French-Canadian Trapper Michael Bourdon for "the great number of these animals on its borders." (BE County, 2014).

During this era, there is some record of navigational use of the Bear River, but mostly of the use of bull and buffalo hide canoes, and other small craft used to travel along checking traps (Crampton and Madsen, 1975; Wells, 1969; Hafen, 1965). In a statistical summary of a collection of accounts from 292 mountain men, Richard Fehrman found that in the accounts of travel, the most frequently used modes of transportation were horses and mules, followed by canoes, bullboats, barges, and keelboats (Fehrman, 1972; Crampton and Madsen, 1975).

During John C. Fremont's second expedition from 1842 to 1843, a survey of the Bear River was using a boat described as an India rubber boat, approximately 18 feet long that carried five to six people and "a considerable amount of equipment (Crampton and Madsen, 1975). However, by the mid-1840s the beaver trade had largely come to a close.

Early Settlement

As the fur trade declined, other uses including mining and cattle grazing attracted settlers to the area. Deweyville is thought to have been the first town established in the Bear River Valley (BE County, 2014). Empey's Ferry was established near Deweyville in 1850 to facilitate travelers passing through the area on their way west to California or north to Oregon (BE County, 2014; Crampton and Madsen, 1975, Denton, 2007).

The Hampton's Ford Ferry was set up in 1853 near Collinston, Utah where Native Americans and fur trappers had often forded the river in a section of gravel bottom (Huchel, 1999). What is thought to be the first bridge across the Bear River was built at the site in 1859 and passersby were charged tolls for its use (Huchel, 1999). Hampton ford became a stop for three different stage companies after the Hampton Ford Inn was built to accommodate passengers (Denton, 2007), and it is now included in the National Register of Historic Places. Other Ferry's operating along the river between 1850 and 1876 included Rick's Ferry and the East-West Ferry in Cache Valley, and Mortensen's Ferry and the Corinne Ferry in Box Elder County (Crampton and Madsen, 1975).

Inn and Bridge at Hampton's Ford, taken by WH Jackson (USGS), in 1872

Mormon settlement in Cache Valley began in 1855 when a group drove a herd of cattle up from the Salt Lake Valley to take advantage of the abundant grasslands (Ricks, 1953). The first permanent settlement, Maughan's Fort was established near Wellsville in 1856 with Providence, Mendon, Logan and Smithfield settled in 1859 (Denton, 2007). In 1867, a group from Wellsville (formerly Maughan's Fort) settled in the Bear River Valley near Portage, Utah and Plymouth was settled in 1869.

Perhaps the first commercial trip from the Great Salt Lake to Corinne was made by the *Kate Connor*, a ninety ton schooner that brought building materials from the Black Rock Mills on the south end of the lake in 1869 (Crampton and Madsen, 1975). The *Kate Connor* also carried passengers between Lake Point and Corinne for $5.00 round trip before later being refitted as a steamer to carry freight (Crampton and Madsen, 1975). The same year, the people of Corinne raised money to build a steamboat to transport both ores and passengers. The *City of Corinne* was built in San Francisco and brought to Corinne by railroad. It was a 150 foot long triple decked ship propelled by a large paddle wheel. The ship was launched with 50 passengers aboard in June of 1871 (Crampton and Madsen, 1975). At the time, the Bear River at Corinne was 13 feet deep and 300 feet wide and was sailing three times a week until business declined just a few months later due to a lack of freight (Jameson, 1951; Crampton and Madsen, 1975). Other navigational reference to the lower Bear River was a Salt Barge that was used to haul salt from along the Bear River to Corinne, where it could be loaded on rail cars and the use of a motorized vessel capable of carrying 25 passengers that was used for pleasure cruises and hunting trips (Crampton and Madsen, 1975).

In anticipation of the arriving railroad, the town of Corinne was incorporated in 1870, shortly after the driving of the Golden Spike at Promontory in 1869. Strategically located where the railroad crossed the Bear River, trade flourished in Corinne with ore coming South from Montana and food and supplies produced in the surrounding valleys shipped back north. The Utah Northern Railroad opened a rail line between Brigham City and Logan in 1873 connecting Cache Valley to Mormon settlements in the Salt Lake Valley and providing new markets for agricultural products. Utah State University was founded in 1888 and remains a significant economic driver in the local economy today.

4.2 Water Development

Settlers were attracted to Box Elder County and the Bear River Valley for its fertile soils and the availability of water resources from the Bear River. John W. Powell and G.K. Gilbert knew very early on that that the Bear River waters would generate controversy (Denton, 2007), and their 1878 report included a request for Congress to provide laws governing priorities and beneficial uses of water to be included in the homestead laws (Jibson, 1990). In fact, one of the first stream-gauging stations in the United States was established near Collinston, Utah in 1889 (Jibson, 1990).

The Bear River Canal was first surveyed as early as 1868, but it wasn't until 1889 when the Bear Lake and River Water Works and Irrigation Company was incorporated and financed the project through the sale of bonds. The diversion dam in Bear River Canyon, where the river leaves cache valley, was built from 1889 to 1890 (Jibson, 1990). Two canals, the west side canal and the Hammond main canal, provided a substantial source of irrigation water to support agricultural development (Denton, 2007). Through a partnership with the Corinne Mill and Canal Stock Company, packaged deals including the sale of both land and water rights were advertised and sold in the Bear River Valley (Denton, 2007). Tremonton, Garland, and Fielding were all established between 1888 and 1892 with other towns and settlements springing up shortly thereafter (Box Elder County, 2014).

In 1912, the Utah-Idaho Sugar Company, which had been a big driver of settlement in the area, and Utah Power and Light entered into a perpetual agreement. The Sugar Company conveyed all the property and infrastructure in the vicinity of the present Cutler Dam to Utah Power and Light in exchange for the delivery of a continuous water flow of 900 cubic feet per second between May 1 and October 31 and 150 cubic feet per second from November to April (Denton, 1990). Utah Power and Light completed the Dingle canal in 1918, connecting the Bear River to Bear Lake and still holds the only right to divert Bear River water into Bear Lake for storage (Jibson, 1990). The upstream storage has allowed downstream users in Cache and Box Elder Counties to obtain water from the Bear River during the dry summer periods when flows would otherwise be very low.

By 1920, 45,000 acres of mostly sugar beets and alfalfa were under cultivation with a canal capacity capable of irrigating another 55,000 acres (Hooton, 2000). The original diversion dam was replaced by the construction of Cutler Dam by Utah Power and Light in 1927 (Jibson, 1990). The two original canals, still known as the West Side Canal and the Hammond Canal, continue in use today under the ownership of the Bear River Canal Company, and irrigation water from the Bear River has made Box Elder County one of the top agricultural areas in the State of Utah with more irrigated farmland than any other county in the state (Hooton, 2000).

The Bear River Compact

Controversy over the Bear River water supply has extended well beyond the borders of Utah. The river both starts and ends in Utah, but it runs through Wyoming and Idaho as it makes its long winding course around the northern end of the Bear River Range. The right to store water in Bear Lake created significant controversy during interstate negotiations to reach an agreement over the use of water from the Bear River. After several years of conflict among the states, Congress granted the right to negotiate and enter into an interstate compact in 1946. Following 12 years of extensive negotiations, lessons learned in how to efficiently allocate water, and a lot of important compromise, the Bear River Compact was signed in 1958 (Jibson, 1990).

Of course, several problems arose from the allocation of water in the 1958 compact. Drought years left such low water flows in the Bear River that it became impossible to convey the water through the canal system (Jibson, 1990). Wyoming and Idaho were also very concerned about Utah's plans to develop their senior water rights. Moreover, the original compact did not place any restriction on the use of ground water, which the states believed could diminish the amount of water available for storage in Bear Lake (Jibson, 1990).

To address many of the issues that arose following the original allocation, the Bear River Compact was amended in 1980. Changes to the agreement included prohibiting the storage of water above Bear Lake when the lake levels fell below 5,911 feet, eliminating a previous reserve of 120,000 acre feet to the Bear River Migratory Bird Refuge, and establishing irrigation as a priority over power generation (Jibson, 1990). The amendment also established specified quantities of water that could be developed by each of the three states. Idaho was given the first right to develop 125,000 acre-feet, Utah was granted the second right for 275,000 acre-feet, and a remaining 150,000 acre-feet was divided between the two states as a third right (Jibson, 1990).

The Bear River Development Act

Water development studies and proposals for the Bear River date back as far as the initial settlement of the area in the late 1800s. Significant research was done by the U.S. Bureau of Reclamation studies in the in the mid 1960s and early 1970 and the Utah Division of Water Resources conducted numerous

studies on potential reservoir locations and storage options in Cache Valley and Box Elder County during the 1970s and 1980s. In 1990, the Utah State Legislature requested a feasibility study for the development of the Bear River water supply and subsequently passed the Bear River Development Act in 1991. The Act states:

> "The Division [of Water Resources] shall develop the surface waters of the Bear River and its tributaries through the planning and construction of reservoirs and associated facilities as authorized and funded by the Legislature; own and operate the facilities constructed; and market the developed waters. The Division is authorized to develop the Honeyville, Barrens, Hyrum Dam, and Avon reservoirs and associated works, including an interconnection from Honeyville Reservoir to Willard Reservoir, and shall proceed with design work, environmental assessments, acquisition of land and rights-of-way, and construction subject to the appropriation of funds for those purposes by the Legislature."

The 1991 Bear River Development Act provides for a diversion of 220,000 acre-feet of water. This developable water supply is allocated among the Jordan Valley Water Conservation District (50,000 acre-feet), the Weber Basin Water Conservancy District (50,000 acre-feet), the Bear River Water Conservancy District (60,000 acre-feet), and Cache County (60,000 acre-feet) (DWRe, 2000).

Several potential reservoir sites and storage options have been proposed over the years, including the expansion of existing reservoirs, the diversion of water into the Amalga Barrens, a dam on the main stem o f the Bear River near Honeyville, a reservoir near Washakie, and even sites in White's Valley or Temple Fork Canyon. The Amalga Barrens and Honeyville sites have been very controversial and were effectively removed from consideration due to environmental and cultural concerns of brought forward by local conservation groups, agricultural producers, and the Shoshone Tribe (DWRe, 2004). Other proposals to divert and store water both above (Cache County, 2013) and below Cutler Dam (DWRe, 2014) continue to be explored.

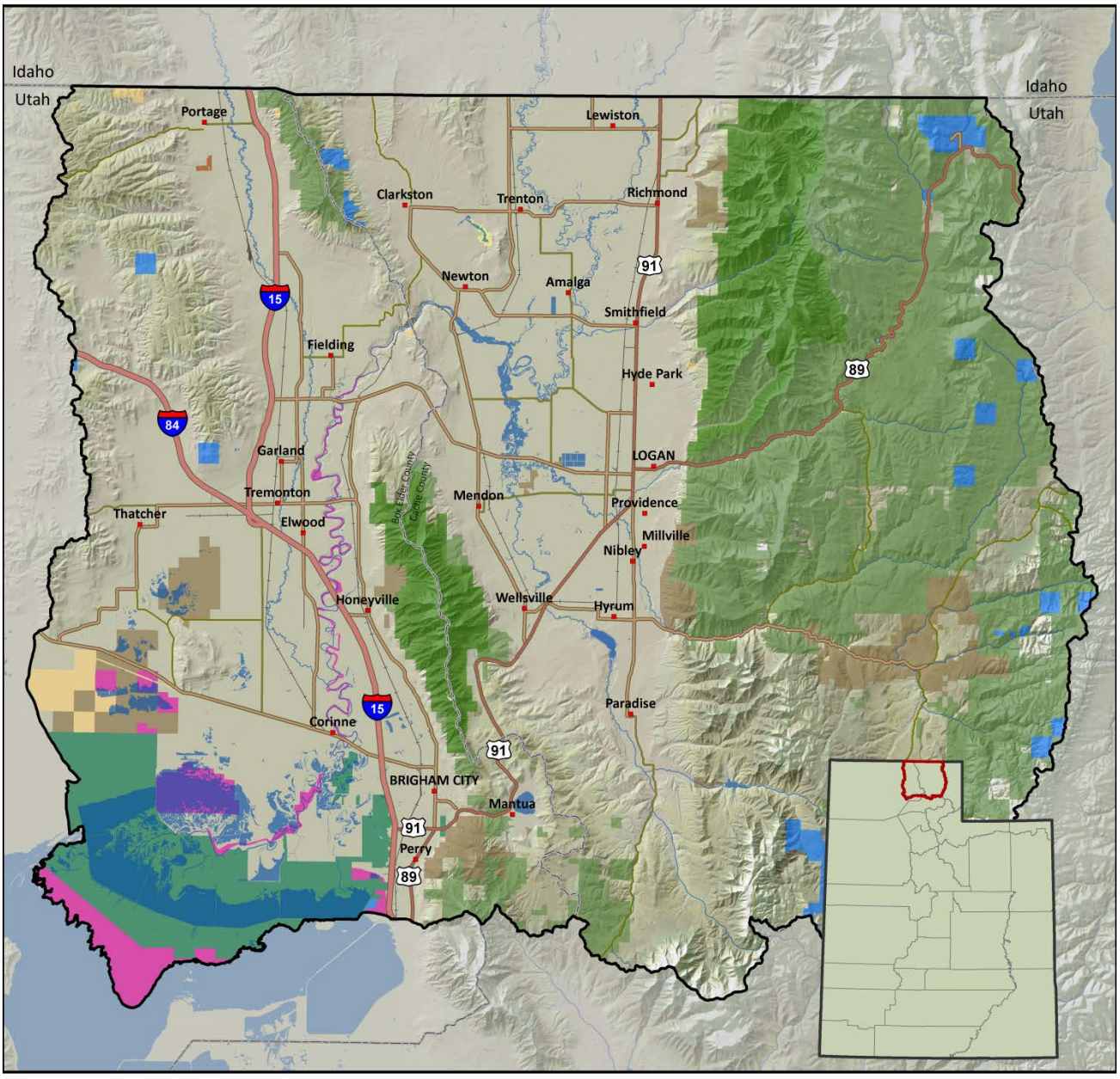
4.3 Current Land Use and Ownership

Agriculture remains the dominant land use in Cache and Box Elder Counties and privately owned agricultural lands comprise the overwhelming majority of lands along the main stem of the Bear River. However, the population has grown substantially in recent decades and urban and residential development are becoming increasingly significant. The majority of public lands are the mountainous areas in the Bear River Range and Wellsville Mountains that are managed by the U.S. Forest Service.

The US Fish and Wildlife service manages a significant protected area at the Bear River Migratory Bird Refuge (approximately 78,000 acres) on the Bear River Delta near the Great Salt Lake. There are also smaller tracts of state-owned land including wildlife management areas and one small park near Hyrum Reservoir, but most of these are located outside of the Bear River Corridor. As described in the introduction, the state does own the bed of all navigable waters in the State of Utah, including the Great Salt Lake and the Bear River. The Division of Forestry Fire and State Lands has been given the management authority for these state sovereign lands.

Maps on the following two pages provide a spatial overview of land ownership in the study area as well as Land Use as defined by the Utah Division of Water Resources "Water-Related Land Use records.

Map 11: Land Ownership



Public Land Ownership

- Bureau of Land Management
- Bureau of Reclamation
- National Forest
- National Wilderness Area
- National Wildlife Refuge
- State Trust Lands
- State Sovereign Land
- State Parks and Recreation
- State Wildlife Reserve/Management Area
- Other State
- Tribal Lands

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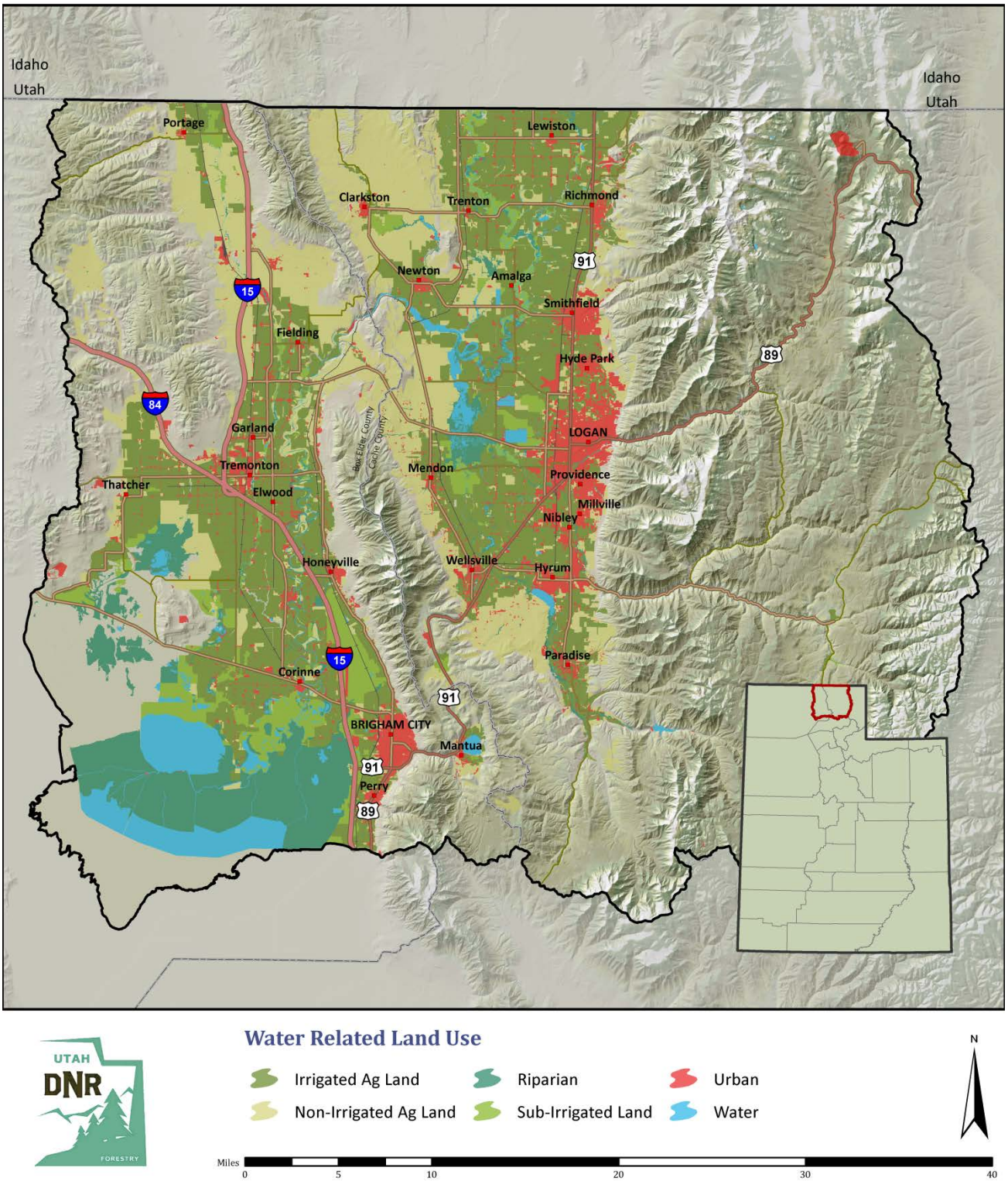
Map 12: Water Related Land Use



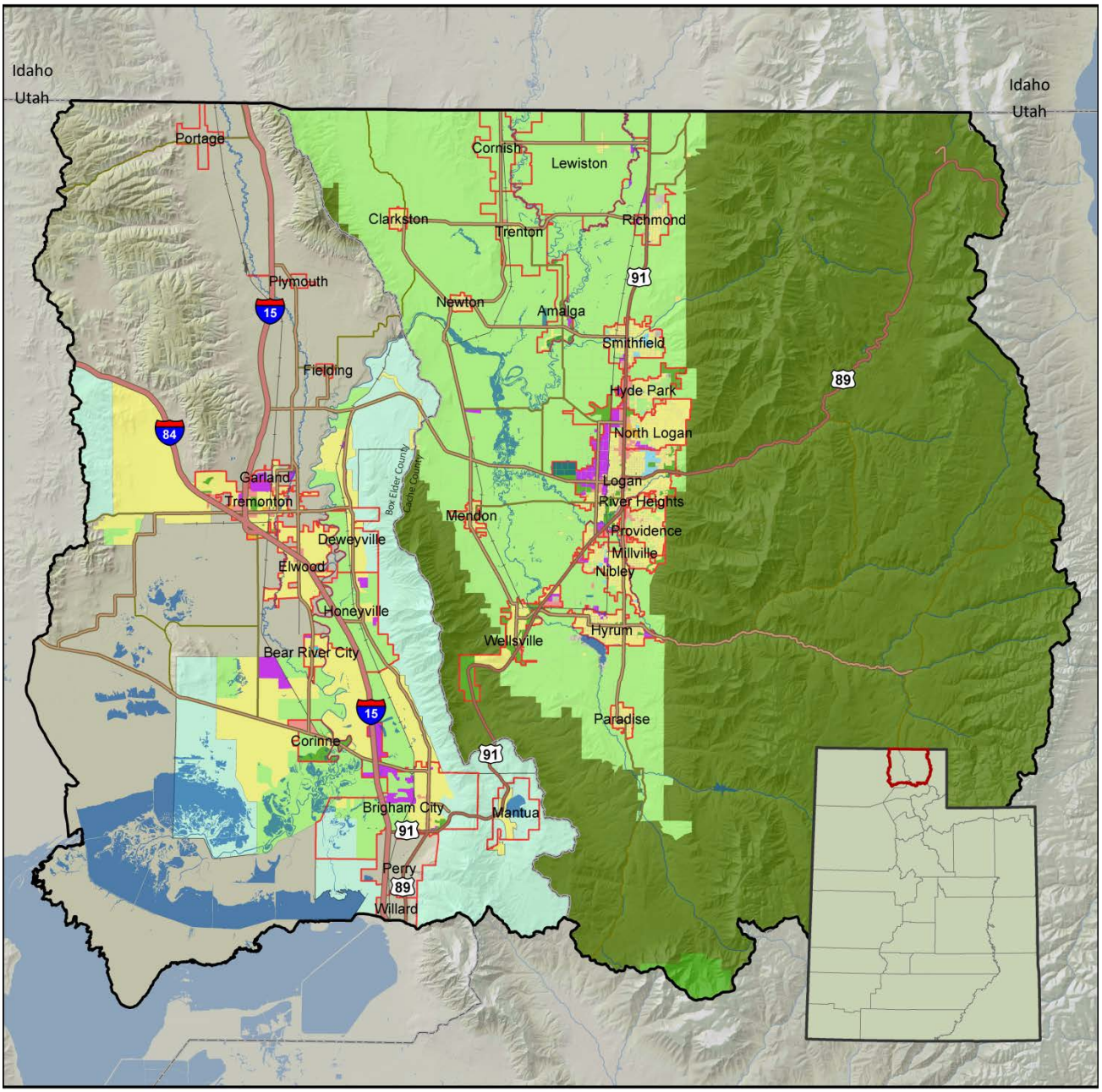
4.4 County and Municipal Zoning

Population growth and the associated urban, suburban, and exurban development in Cache County and the Bear River Valley are significant drivers for changing land uses in Cache Valley. Where this development occurs is highly related to the zoning ordinances enacted by Cache and Box Elder Counties as well as the various municipalities within the area. Several areas have established zoning Classifications directly adjacent to the river.

The map on the following page shows county and municipal level zoning for the study area that was collected from a number of sources. County level zoning was available from the Cache and Box Elder County Planning and GIS offices. Some of the municipal zoning in Cache County was also made available by a 2010 project that aimed to create a county-wide zoning map for all land areas. Where updated municipal zoning was found for these municipalities it has been digitized and updated in the map. Zoning in Box Elder County, on the other hand, only covers a portion of the land base because there are no zoning ordinances for many areas of the County. With the exception of Brigham City, most of the municipal zoning in Box Elder County was obtained in the form of paper maps or PDF documents that were digitized in ArcGIS.

While each municipality has several detailed zoning classifications that specify different types of residential development, concentration of commercial development, etc. the zoning presented in the map has been generalized to include eight primary classifications including: commercial, residential, manufacturing/industrial, agricultural, open space/recreation, forest recreation, multiple use (Box Elder County), and special zones such as PUD and D-Z that generally allow for higher density residential development.

Map 13: Current County and Municipal Zoning



4.5 Current Recreational Use and Facilities

Most outdoor recreation within the study area occurs on public lands managed by the U.S. Forest Service, with some additional recreation opportunities provided by reservoirs and limited public lands in the lower elevation valley bottoms. Potential recreational opportunities along the river include fishing (warm-water species), hunting, bow fishing, wildlife viewing, boating, canoeing, and hiking. The primary river-based recreational sites are surrounding Cutler Reservoir and include boat launching facilities, picnic areas, a canoe trail, and limited walking opportunities (PacifiCorp, 1995). PacifiCorp Power owns a substantial amount of land along the river in Cache Valley. They allow public access to most of these lands and maintain the recreational facilities around the reservoir (PacifiCorp, 2013).

The sport fishing pressure on Cutler Reservoir is limited primarily to road access points and is classified as low to moderate with negligible boat angling. Primary sport fish targets appear to be channel catfish, black bullhead, and carp (Budy et al. 2007), as well as black crappie. The Utah state catch and release record for channel catfish was recorded with a 36" fish at Cutler Reservoir in April of 2013. Fishing for large channel catfish is also very popular on lower stretches of the Bear River from Corinne into the Bear River Migratory Bird Refuge.

There has been a growing interest in many areas of the country to fly-fish for warm-water species, including the common carp that have become prevalent throughout the Lower Bear River. While it is doubtful that many anglers are currently targeting carp with a fly rod in the Bear River, it is an option that may become more popular in the future. Both waterfowl and upland bird hunting are popular in many areas along the Bear River and access points are often occupied by boat trailers during those seasons. There are also opportunities for trapping Beaver and Muskrat along the river.

Perhaps the most significant recreational opportunity along the Bear River through Cache and Box Elder Counties is simply wildlife viewing. As discussed in the wildlife section of this report, there is a rich diversity of bird species that inhabit different areas along the river. The Bridgerland Audubon Society and the Bear River Land Conservancy frequently host public outings to go out and see the many different species of migratory birds that can be found in the area.

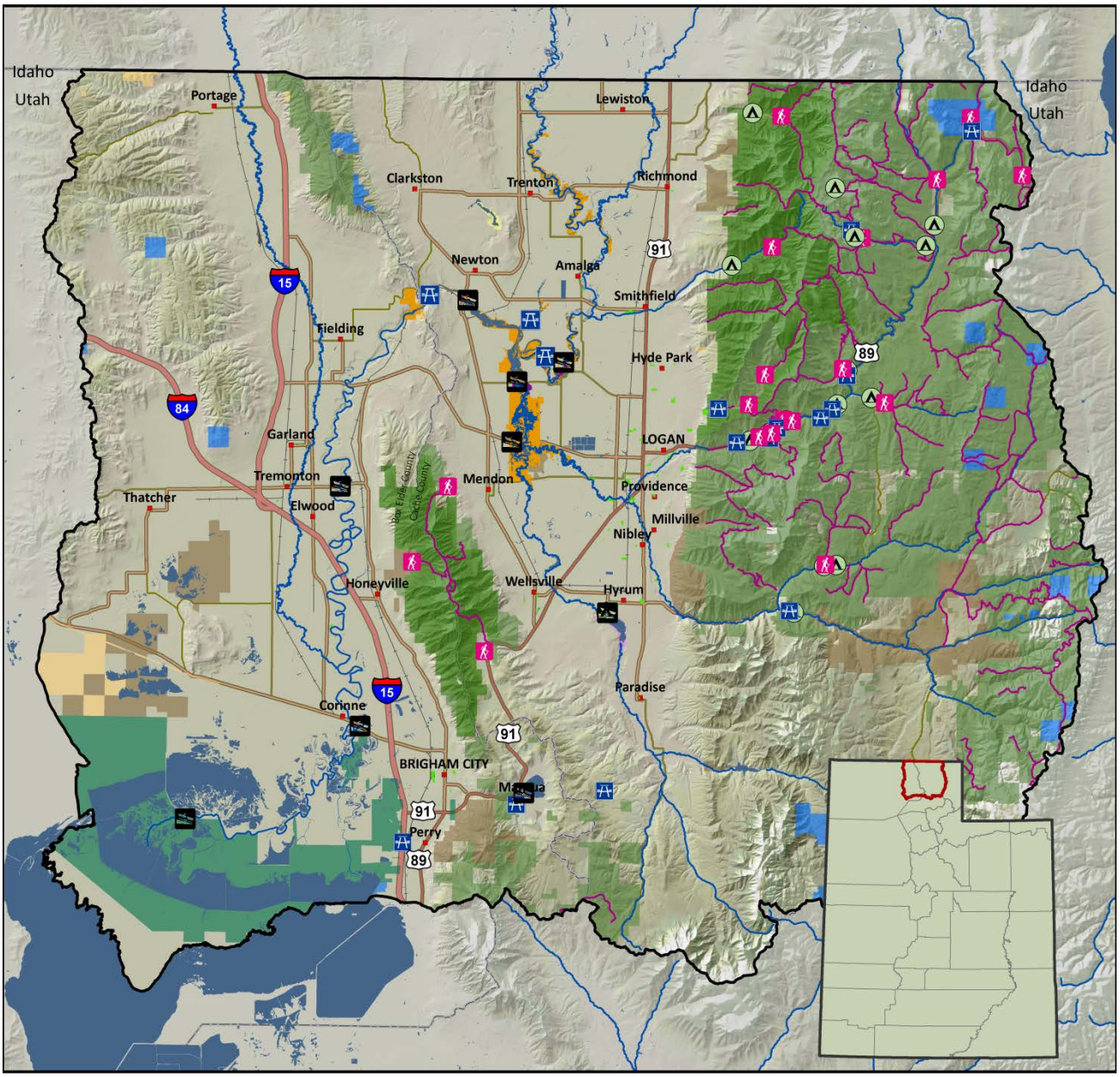
One significant barrier to the recreational use of the river is the difficulty for the public to gain access in most areas. The vast majority of land along the river corridor is privately owned (see Map 11). PacifiCorp allows public access to lands they own along the river, but their properties upriver from Cutler Reservoir can be difficult to access because they are often land-locked by surrounding private lands. There are no developed recreational or access facilities upriver from the Upper Bear Access Point in Benson, making the launch of canoes and kayaks difficult and larger boats nearly impossible. Providing additional and improved public access may be an important part of increasing public awareness regarding the value of the Bear River as a public resource.

4.6 2013 Inventory of Structures and Devices

In 2013, an inventory was completed to identify structures and devices along the Bear River that likely will require permits from the Division of Forestry, Fire and State Lands. The inventory required approximately three weeks of field work, floating and canoeing the river from just north of the Utah-Idaho Border to Cutler Dam (completed in August 2013) and from Cutler Dam downstream into the Bear River Migratory Bird Refuge (completed primarily in November 2013).

Over 200 structures or devices were identified and logged with photographs and/or gps coordinates. These structures include irrigation pumps (big and small), power transmission lines, bridges, pilings, docks, ramps, and other improvements that are on, over, or below sovereign lands of the Bear River. Map 15 provides a representation of the gps points taken for each structure or device along the river. In addition to the inventory, a gps track was also obtained during each leg of the trip. When compared to existing GIS data for the Bear River and recent (2014 NAIP) imagery, the gps track seems to more accurately capture the main channel of the Bear River in sections where it may have recently diverged from its previous course.

Map 14: Recreational Access/Facilities



Recreation Facilities

- Boat Ramps
- CAMPING AREA
- Campground
- TRAILHEAD
- DAY USE AREA
- Picnic Site

Public Access Lands

- Local Parks
- Bureau of Land Management
- Bureau of Reclamation
- National Forest
- National Wilderness Area
- National Wildlife Refuge
- State Trust Lands
- State Parks and Recreation
- State Wildlife Reserve/Management Area
- PacifiCorps Lands

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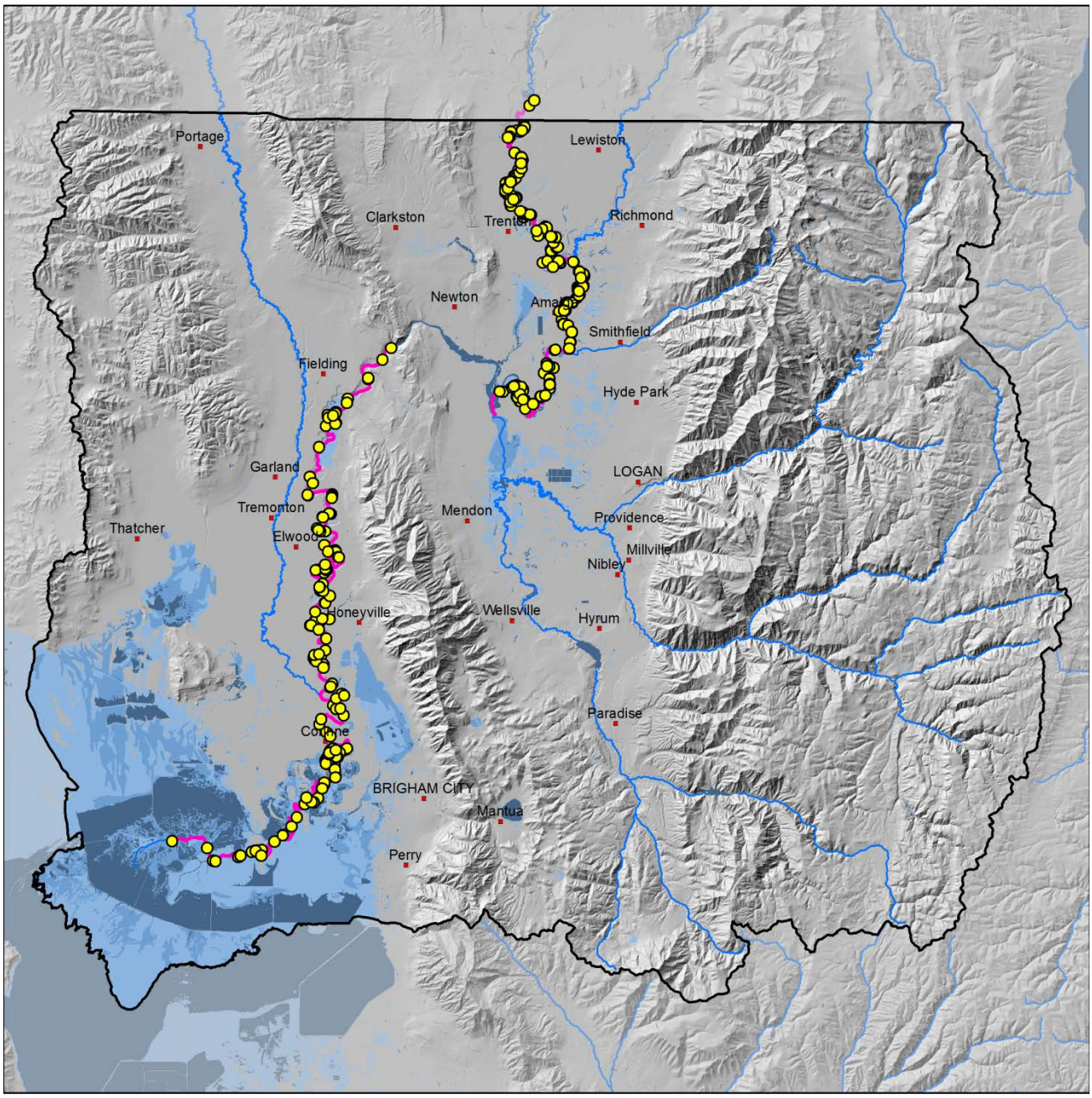
Map 15: 2013-2014 Inventory



4.6 Growth and Development

Population Growth

Recent trends in population growth within Cache and Box Elder Counties are expected to continue for the foreseeable future. Most associated residential and commercial development is expected to take place within existing incorporated municipalities. Cache County is expected to continue developing more rapidly than Box Elder County, with county-wide growth rates of 106% and 41%, respectively, from the 2010 census to year 2050 (GOMB, 2013). However, the Box Elder County growth projections include the entire county and most development is expected to occur within the eastern portion that has been included in the study area. Most of this growth can likely be attributed to spill-over from the Wasatch front area. As areas along the rapidly growing Wasatch front continue to build out, residents seeking rural and suburban areas will tend to look to build or buy further north. This is illustrated by higher population growth projections in the southern areas of both Cache and Box Elder Counties that have a higher potential to accommodate commuters traveling back and forth to the Wasatch Front.

Tables 6 and 7 show population projections – broken down by municipality – for the Cache and Box Elder Counties according to estimates from the Utah Governor's Office of Management and Budget.

Table 6: 2012 Baseline City Population Projections (2010-2050) for Box Elder County, UT

	2010	2020	2030	2040	2050	2060	Growth 2010-50	% Growth 2010-50
Box Elder County	**49,975**	**54,571**	**59,437**	**64,704**	**70,501**	**77,030**	**20,526**	**41.07%**
Bear River City	**853**	**871**	**951**	**971**	**1,058**	**1,155**	**205**	**23.98%**
Brigham City	17,899	19,100	21,397	22,970	25,028	27,346	7,129	39.83%
Corinne city	**685**	**764**	**892**	**1,035**	**1,058**	**1,232**	**373**	**54.38%**
Deweyville town	**332**	**355**	**398**	**434**	**494**	**578**	**162**	**48.65%**
Elwood town	**1,034**	**1,252**	**1,486**	**1,682**	**1,974**	**2,157**	**940**	**90.91%**
Fielding town	455	491	505	582	635	770	180	39.45%
Garland city	2,400	2,783	3,066	3,452	3,525	3,852	1,125	46.88%
Honeyville city	**1,441**	**1,419**	**1,647**	**1,754**	**2,039**	**2,278**	**598**	**41.53%**
Howell town	245	273	297	324	353	385	108	43.88%
Mantua town	687	709	773	841	987	1,001	300	43.67%
Perry city	4,512	5,566	6,538	7,764	8,531	10,168	4,019	89.07%
Plymouth town	414	478	553	635	561	557	147	35.46%
Portage town	245	218	238	259	282	308	37	15.10%
Snowville town	167	164	178	162	141	154	-26	-15.57%
Tremonton city	**7,647**	**8,731**	**9,510**	**10,353**	**11,985**	**13,480**	**4,338**	**56.73%**
Willard city	1,772	1,945	2,036	2,182	2,545	2,773	773	43.60%
Other Box Elder County	9,187	9,452	8,971	9,305	9,308	8,835	121	1.32%

Table 7: 2012 Baseline City Population Projections (2010-2050) for Cache County, UT

	2010	2020	2030	2040	2050	2060	Growth 2010-50	% Growth 2010-50
Cache County	**112,656**	**139,228**	**168,136**	**196,559**	**232,468**	**273,817**	**119,812**	**106.35%**
Amalga town	**488**	**540**	**587**	**603**	**930**	**1,095**	**442**	**90.55%**
Clarkston town	666	696	841	983	1,162	1,369	496	74.53%
Cornish town	**288**	**332**	**362**	**384**	**465**	**548**	**177**	**61.44%**
Hyde Park city	3,833	4,930	6,214	7,552	7,673	8,454	3,840	100.19%
Hyrum city	7,609	9,328	11,079	12,794	15,851	19,012	8,242	108.33%
Lewiston city	**1,766**	**1,777**	**2,186**	**2,555**	**3,487**	**3,833**	**1,721**	**97.45%**
Logan city	48,174	57,057	63,943	76,658	92,987	111,717	44,813	93.02%
Mendon city	1,282	1,689	2,239	2,555	2,790	3,286	1,508	117.60%
Millville city	1,829	2,196	2,593	2,951	3,834	4,673	2,005	109.61%
Newton town	789	835	841	983	1,162	1,369	373	47.32%
Nibley city	5,438	8,796	14,136	15,725	18,597	21,905	13,159	241.99%
North Logan city	8,269	11,641	14,964	16,708	18,597	21,905	10,328	124.91%
Paradise town	904	1,123	1,334	1,552	1,879	2,236	975	107.88%
Providence city	7,075	9,050	11,770	13,759	16,273	19,167	9,198	130.00%
Richmond city	2,470	2,785	3,026	3,342	4,184	5,203	1,714	69.41%
River Heights city	1,734	2,088	2,152	2,258	2,557	3,012	823	47.47%
Smithfield city	9,495	12,051	15,171	18,307	19,069	21,245	9,574	100.83%
Trenton town	**464**	**557**	**673**	**786**	**930**	**1,095**	**466**	**100.40%**
Wellsville city	3,432	4,160	5,036	5,831	7,098	8,444	3,666	106.82%
Cache County	6,651	7,597	8,991	10,274	12,941	14,247	6,290	94.57%

Changing Land Uses

Urban, suburban, and exurban development are already displacing agriculture in terms of both land use and water use in many areas of the United States (American Farmland Trust, 2014). Cache and Box Elder County are not immune from such changes in land and water use. Increased pressure for the development of land and water resources within the study area is likely to have a significant impact on the agricultural lands that provide the majority of open space resources in the valley bottoms. While these agricultural areas are not natural, they do often provide benefits in terms of wildlife habitat (USFWS, 2013) and the quantity of water that is returned into the riverine system in the form of return flows than would likely be realized in areas developed for commercial or residential uses. Additionally,

agricultural lands have played a critical role in the historic development of the area and are frequently cited among the most important factors in terms of cultural resources, regional identity, and sense of place.

The loss of farmland in upland areas that are suitable for residential development may create a demand to drain and cultivate more farmland along the river. Without intervention, this could exacerbate the fragmentation of important wildlife habitat as well as the displacement of wetland areas that currently act as buffers and filters that benefit water quality within the ecosystem. Furthermore, the quantity of water in the Bear River, especially in Box Elder County, is highly dependent on return flows from agriculture (UDWQ, 2010). In addition to water quality and potential seasonal flooding associated with increases in non-permeable land cover, stormwater and runoff in developed areas is generally represents more of a closed system and is unlikely to put as much water back into the river as agricultural water users have in the past.

The Bear River flood plain is not considered the most suitable place to build due to risks of flooding, unstable soils, and high water tables. Historically, very few residences have been built along the river. As discussed previously, however, riparian areas often attract new residents due to their natural environment and aesthetic allure, and there may be significantly more residential development along the river as population growth continues and new residents move north from the Wasatch front in search of more rural properties and lifestyles. The residential development being built around the water-ski park next to highway 30 near Collinston represents one example of new development that may become more commonplace along the river in coming decades.

Changes in land use along the river, whether from residential development or changing agricultural uses, have the potential to displace significant areas of critical wildlife habitat and have detrimental effects on water quality and quantity within the system. While not immediately apparent in many cases, subtle changes in land use along the river should be closely monitored to evaluate the potential impacts of further development in sensitive areas.

Water Development

Utah is the second driest state in the nation and also one of the fastest growing. Population growth within the study area (described above), the larger Bear River Basin, and even areas outside the watershed along the Wasatch Front are increasing the pressure to develop additional water resources. As mentioned earlier, the Bear River is considered one of the few areas in the state with a significant amount of developable water (DWRe, 2000) that could be tapped to support additional residential, commercial, and industrial development beyond the current capacity of our existing water systems and storage reservoirs.

In addition to the diversion of water below Cutler Dam, Cache County completed a water master plan in 2013 that identified developing their allocated 60,000 acre feet of water as a priority for meeting future water needs above Cutler Dam (Cache County, 2013) and maintaining their allocation of the water amidst the increasing pressure for development downstream to service the Wasatch Front. For a complete overview of potential water development projects, refer to the Bear River Pipeline Concept document completed for the Division of Water Resources in 2014 (BCA & HDR, 2014).

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